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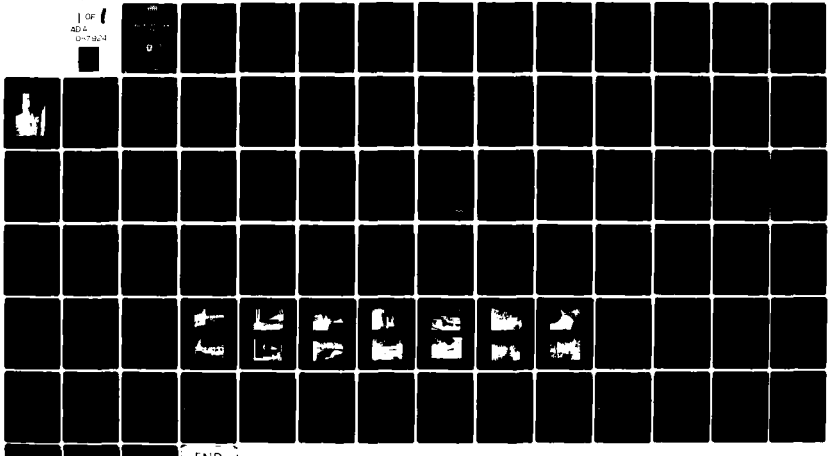

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PASSAIC RIVER BASIN
HOKUS CREEK, BERGEN COUNTY
NEW JERSEY

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SHADOW LAKE DAM
NJ 00232

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DACW61-79-C-0011

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DEPARTMENT OF THE ARMY

Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

MARCH 1980

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SECURITY CLASSIFICATION OF THIS PAGE (When D Entered)

REPORT DOCUMENTATION PAGE

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Copies are obtainable from National Technical Information Service, Springfield, Virginia 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dams	National Dam Safety Program
Emabnkments	Shadow Lake Dam, New Jersey
Visual Inspection	Spillways
Structural Analysis	Erosion

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-N

05 AUG 1980

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Shadow Lake Dam in Bergen County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Shadow Lake Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. The dam's spillway is considered inadequate because a flow equivalent to 21 percent of the One Hundred Year Flood would cause the dam to be overtopped. To ensure adequacy of the structure, the following actions as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Within three months of the consultant's findings, remedial measures to ensure spillway adequacy should be initiated.

b. Within twelve months from the date of approval of this report, the following remedial actions should be completed:

(1) Repair the spalled concrete pier and the cracks in the concrete headwall of the low-level outlet.

(2) Fill in the voids between the bottom of the concrete apron and the supporting rubble wall at the bottom of the channel.

(3) Provide a concrete headwall and apron at the discharge end of the low-level outlet.

(4) Remove all vegetation from the bottom of the discharge channel and fill in the voids along the right retaining wall.

(5) Fill in and reseed the eroded areas along the embankment crest.

(6) Investigate the embankment for animal burrows and fill in any burrow holes with impervious material.

(7) All brush and trees should be removed from the downstream and upstream slopes to avoid problems which may develop from roots. The embankment face should then be seeded to develop a growth of grass for surface erosion protection.

c. Within three months from the date of approval of this report, the following actions should be initiated.

(1) The owner should develop an emergency action plan outlining actions to be taken by the operator to minimize downstream effects of an emergency and establish a flood warning system for the downstream communities.

(2) Consider providing additional low-level outlet facilities, to decrease drawdown time.

d. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam withn one year from the date of approval of this report.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Maguire of the Seventh District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

NAPEN-N
Honorable Brendan T. Byrne

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

SHADOW LAKE DAM (NJ00232)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 26 November and 27 November 1979 by Harris-ECI Associates, Inc., under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Shadow Lake Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. The dam's spillway is considered inadequate because a flow equivalent to 21 percent of the One Hundred Year Flood would cause the dam to be overtopped. To ensure adequacy of the structure, the following actions as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Within three months of the consultant's findings, remedial measures to ensure spillway adequacy should be initiated.

b. Within twelve months from the date of approval of this report, the following remedial actions should be completed:

(1) Repair the spalled concrete pier and the cracks in the concrete headwall of the low-level outlet.

(2) Fill in the voids between the bottom of the concrete apron and the supporting rubble wall at the bottom of the channel.

(3) Provide a concrete headwall and apron at the discharge end of the low-level outlet.

(4) Remove all vegetation from the bottom of the discharge channel and fill in the voids along the right retaining wall.

(5) Fill in and reseed the eroded areas along the embankment crest.

(6) Investigate the embankment for animal burrows and fill in any burrow holes with impervious material.

(7) All brush and trees should be removed from the downstream and upstream slopes to avoid problems which may develop from roots. The embankment face should then be seeded to develop a growth of grass for surface erosion protection.

c. Within three months from the date of approval of this report, the following actions should be initiated.

(1) The owner should develop an emergency action plan outlining actions to be taken by the operator to minimize downstream effects of an emergency and establish a flood warning system for the downstream communities.

(2) Consider providing additional low-level outlet facilities, to decrease drawdown time.

d. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

APPROVED: _____

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: _____

PASSAIC RIVER BASIN

HOHOKUS CREEK, BERGEN COUNTY

NEW JERSEY

SHADOW LAKE DAM

NJ00232

PHASE I INSPECTION REPORT.

NATIONAL DAM SAFETY PROGRAM.

DEPARTMENT OF THE ARMY

PHILADELPHIA DISTRICT, CORPS OF ENGINEERS

PHILADELPHIA, PENNSYLVANIA 19106

MARCH 1980

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

Name:	Shadow Lake Dam, I.D. NJ 00232
State Located:	New Jersey
County Located:	Bergen County
Stream:	Hohokus Creek
River Basin:	Passaic River
Date of Inspection:	November 26 and 27, 1979

Assessment of General Conditions

Shadow Lake Dam is an earthfill dam containing a concrete weir spillway with flashboards at the right end of the dam. The overall condition of the dam is good. There are no major signs of distress or instability in the embankment. The right concrete pier supporting the foot bridge and the flashboards is severely deteriorated. The downstream channel is well defined but has heavy vegetation growing on the bottom along the left retaining wall. The hazard potential is recommended to be downgraded from "high" to "significant".

The adequacy of Shadow Lake Dam is considered questionable in view of its lack of spillway capacity to pass the 100-year flood, which is the SDF for the dam, without overtopping the dam. The spillway is capable of passing a flood equal to 20 percent of the SDF (100-year storm) and is assessed as "inadequate".

At present, the engineering data available is not sufficient to make a definitive statement on the stability of the dam, but based on the findings of the visual inspection the preliminary assessment of static stability is that it is satisfactory. The following actions are recommended along with a timetable for their completion. All recommended actions should be conducted under the supervision of an Engineer who is experienced in the design, construction and inspection of dams:

1. Carry out a more precise hydrologic and hydraulic analysis of the dam within twelve months, to determine the need and type of mitigating measures necessary. If required, conduct a study of the means of increasing spillway discharge capacity and develop alternative schemes for construction. This should include the installation of headwater and tailwater gages. The ability of the dam to withstand overtopping should also be studied.

2. Repair spalled concrete pier and concrete headwall of the low-level outlet within twelve months.

3. Fill in the voids between the bottom of the concrete apron and the supporting rubble wall at the bottom of the channel. This should be completed within twelve months.

4. Provide a concrete headwall and apron at the discharge end of the low-level outlet. This work should be completed within twelve months.

5. Remove all vegetation from the bottom of the discharge channel and fill in the voids along the right retaining wall, within twelve months.

6. Fill in and reseed the eroded areas along the embankment crest. This work should be started within twelve months.

7. Investigate the embankment for animal burrows and fill in any burrow holes with impervious material.

8. All brush and trees, should be removed from the downstream and upstream slopes to avoid problems which may develop from roots. The embankment face should then be seeded to develop a growth of grass for surface erosion protection. This program should be started within twelve months.

9. The owner should develop an emergency action plan (if one is not already available) outlining actions to be taken by the operator to minimize downstream effects of an emergency and establish a flood warning system for the downstream communities within three months.

Furthermore, while of a less urgent nature, the following additional action is recommended and should be carried out within twenty-four months:

1. Consider providing additional low-level outlet facilities, to decrease drawdown time.

2. The owner should develop within one (1) year after formal approval of the report, written operating procedures and a periodic maintenance plan to insure the safety of the dam.

John P. Talerico, P.E.
HARRIS - ECI ASSOCIATES

Photo taken on February 8, 1980

S H A D O W L A K E D A M

View from left edge of dam toward spillway, underneath foot bridge, at right edge of dam. Low-level outlet structure, concrete headwall, is shown at center of photo.

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

SHADOW LAKE DAM, I.D. NJ00232

SECTION 1

1. PROJECT INFORMATION

1.1 General

a. Authority

The National Dam Inspection Act (Public Law 92-367, 1972) provides for the National Inventory and Inspection Program by the U.S. Army Corps of Engineers. This inspection was made in accordance with this authority under Contract C-FPM No. 35 with the State of New Jersey who, in turn, is contracted to the Philadelphia District of the Corps of Engineers, and was carried out by the engineering firm of Harris-ECI Associates of Woodbridge, New Jersey.

b. Purpose of Inspection

The visual inspection of Shadow Lake Dam was made on November 26 and 27, 1979. The purpose of the inspection was to make a general assessment as to the structural integrity and operational adequacy of the dam embankment and its appurtenant structures.

c. Scope of Report

The report summarizes available pertinent data relating to the project; presents a summary of visual observations made during the field inspection; presents an evaluation of hydrologic and hydraulic conditions at the site; presents an evaluation as to the structural adequacy of the various project features; and assesses the general condition of the dam with respect to safety.

1.2 Description of Project

a. Description of Dam and Appurtenances

Shadow Lake Dam is an earthfill dam approximately 565 feet long and 10 feet high with a clay core. There is a 28 foot wide paved channel spillway at the right end of the dam. The crest of spillway is 2.9 feet below the top of the embankment. There are flashboards totalling 12 inches high, spanning the spillway. The boards are held in place by slots in the abutments and two-2 foot x 2 foot slotted concrete piers equally spaced across the spillway.

The embankment has a top width varying from 14 feet to 26.5 feet with the downstream slope of 3H:1V and the upstream slope varying from 1H:1V to a flat beach. The 1H:1V slope is from the left end of the dam to the low-level outlet. The beach starts at the spillway's left abutment and extends to the left for a distance of approximately 129 feet. In between the low-level outlet and the beach, there is a vertical grouted rubble wall retaining the embankment. In this section the crest width is 26.5 feet maximum.

The low-level outlet (see Photos 6 & 7) consists of an 18-inch reinforced concrete pipe through the dam appoximately 347 feet left of the spillway. The inlet end is a concrete drop inlet with a 3 foot by 4 foot steel plate cover. The inlet is supported by the concrete headwall for the 18-inch pipe. The flow through the outlet is controlled by manually removing a 2 foot wide steel plate situated in slots at the lakeward side of the inlet. The outlet discharges to the other side of the service road directly into the downstream channel.

A wooden plank foot bridge with timber girders span the spillway. The bridge is supported on the spillway abutment walls and by two wooden T-beams resting on the flashboard piers.

The downstream spillway channel is contained within concrete retaining walls for a distance of approximately 90 feet. The channel has a concrete bottom 28 feet wide at the spillway, narrowing to about 23 feet at a distance of approximately 18 feet from the spillway. From there, until it crosses under the bituminous service road, the channel has a rubble stone bottom. The channel crosses under the service road through two 48-inch reinforced concrete pipes. Beyond the road the channel turns to the left and parallels the road to just past the low-level outlet where it turns to the right and runs into a swampy area.

There are no records of any soil borings or test pits for this dam.

A generalized description of the soil conditions is contained in Report No. 4, Bergen and Hudson Counties, Engineering Soil Survey of New Jersey, by Rutgers Unversity. The report describes the area as various Wisconsin glacial deposits and swamp. The underlying deposits are either glacial marginal moraine and/or stratified drift. Glacial marginal moraine is unstratified, heterogeneous material, including clay, silt and sand sizes with varying amounts of gravel, cobbles and boulders. Stratified drift is composed of sand sizes with varying amounts of silt and gravel. The depth to the underlying rock is generally greater than 20 feet. Geologic Overlay Sheet 23 describes the rock around the lake as the Brunswick formation of shale interbedded with sandstone.

b. Location

Shadow Lake Dam is located on Hohokus Creek in the Borough of Franklin Lakes, Bergen County, New Jersey. It is accessible by way of Briarly Drive.

c. Size Classification

According to the "Recommended Guidelines for Safety Inspection of Dams" by the U.S. Department of the Army, Office of the Chief of Engineers, the dam is classified in the dam size category as being "small", since its storage volume of 155 acre-feet is less than 1,000 acre-feet. The dam is also classified as small because its height of 10 feet is less than 40 feet. The overall size classification of Shadow Lake Dam is small.

d. Hazard Classification

A hazard potential classification of "significant" has been assigned to the dam. This is based on the facts that there are only two residential structures immediately downstream and they are above the flood reach, that the service road immediately downstream is lightly traveled and that there are tennis courts and a swimming pool along the left bank contributing to the high recreational use of the area. Therefore the possibility exists of the loss of a few lives in the event of dam failure.

e. Ownership

Shadow Lake Dam is owned by:

Shadow Lake, Inc.
230 Arbor Road
Franklin Lakes, NJ 07417

Attention: Mr. Albert B. Fisher, Jr.
President
(201) 791-5192

f. Purpose

Shadow Lake Dam is presently used for recreational purposes only.

g. Design and Construction History

A permit to construct Shadow Lake Dam (then known as Camp Caw Dam) was issued on June 13, 1928 and the dam was completed in September, 1928. Modifications have been made to the entire dam including the low-level outlet, embankment and the spillway. There is no data on file indicating when the modifications were completed. The spillway, according to the owner, was modified in 1957.

h. Normal Operating Procedures

The discharge from the lake is unregulated and is allowed to naturally balance the inflow into the lake. The low-level outlet is used to lower the lake level occasionally to allow the lake front owners to make repairs to their property and to clean the lake bottom.

1.3 Pertinent Data

a. Drainage Area	1.94 sq. mi.
b. Discharge at Dam Site	
Ungated spillway capacity at elevation of top of dam:	213 cfs (356.91 NGVD)
Total spillway capacity at maximum pool elevation (SDF):	2,714 cfs (358.25 NGVD)
c. Elevation (Feet above NGVD)	
Top of dam:	356.91
Maximum pool design surcharge (SDF):	357.95
Spillway crest:	354 (Concrete Weir) 355 (Flashboards)
Streambed at centerline of dam:	346.5 (estimated)
Maximum tailwater:	348.0 (estimated)
d. Reservoir	
Length of maximum pool:	1,400 ft. (estimated)
Length of recreation pool:	1,300 ft. (estimated)
e. Storage (acre-feet)	
Spillway Crest:	55
Flashboards:	75
Top of dam:	119
Maximum pool (SDF):	155
f. Reservoir Surface (acres)	
Top of dam:	23.0 (estimated)
Maximum pool (SDF):	28.1 (estimated)
Flashboards:	20.7 (355 NGVD)
Spillway crest:	18.4 (354 NGVD)

g. Dam

Type:	Earthfill with concrete weir and flashboards.
Length:	565 ft. (effective)
Height:	10 ft.
Top width:	Varies, 14 ft. to 26.5 ft.
Side slopes - Upstream:	Varies, 1H:1V to Vertical to flat beach
- Downstream:	3H:1V
Zoning:	Unknown
Impervious core:	565 ft. clay core
Cutoff:	Unknown
Grout curtain:	None

h. Diversion and Regulating Tunnel

N/A

i. Spillway

Type:	Concrete broad crest weir with flashboard
Length of weir:	24.5 ft.
Crest elevation:	354 NGVD
Gates:	None
U/S Channel:	Shadow Lake
D/S Channel:	Natural channel with some riprap on the bank.

j. Regulating Outlets

Low level outlet:	18-inch RCP
Controls:	Steel plate slide gate
Emergency gate:	None
Outlet:	346.94 NGVD

SECTION 2

2. ENGINEERING DATA

2.1 Design

There are no known design drawings of the original dam or any subsequent modifications. However, old W.P.A. topographic drawings of the lake are available from Boswell Engineering Co, Ridgefield Park,New Jersey. One drawing entitled W.P.A. New Jersey, Riparian and Stream Survey dated January 14, 1937 shows topographically the dam and channel as it existed in 1937. An accompanying drawing shows the dam and channel profile along with typical channel cross-sections. No data from soil borings, soil tests, design computations or other geotechnical data is available to assess the stability properly. Data concerning the hydraulic capacity of the spillway is also unavailable.

2.2 Construction

Data is not available concerning the as-built construction or modifications of the dam. No data exists of construction methods, borrow sources, or other data pertinent to the construction of the dam.

2.3 Operation

Formal operation records are not kept for the dam and reservoir. The lake is allowed to operate naturally without regulation.

2.4 Evaluation

a. Availability

The availability of engineering data is very poor. No plans, computations, or correspondence concerning the original construction or modifications of the dam are available from the NJ-DEP.

b. Adequacy

The engineering data obtained in the field was adequate to perform hydrologic and hydraulic computations. The data was insufficient to perform a stability analysis, but preliminary evaluation could be made based on visual observations.

c. Validity

It is obvious from the field inspection, that there have been many modifications to the dam since 1937, making the W.P.A. plans of limited value. Since no existing engineering data exists, other than the W.P.A. plans, the validity of that data could not be compared to the data obtained in the field.

SECTION 3

3. VISUAL INSPECTION

3.1 Findings

a. General

The visual inspection of Shadow Lake Dam revealed the dam and spillway to be in good condition but in need of repair. At the time of inspection the lake level was just below the crest of the spillway.

b. Dam

The earth embankment appears to be sound. No surface cracking on the embankment or at the toe was noted. Minor erosion at two locations were noted on the embankment's downstream slope. Erosion at these locations was due to the locations being used as footpaths. Some cavities were observed along the embankment crest, upstream side, behind the grouted rubble wall. Also, there is minor erosion along the back of the right retaining wall of the discharge channel. The horizontal alignment of the crest is good. The vertical alignment is generally good but in some areas there appear to be minor irregularities near the shore line. Numerous birch trees are growing along the upstream slope left of the low-level outlet and along the entire downstream slope. Also there are large evergreen trees growing on the downstream slope between the low-level outlet and the beach area. No seepage or sloughing was found in any portion of the downstream embankment face. No evidence of burrowing by animals was observed; however, at the time of the inspection, the embankment was partially masked by dense vegetation; therefore, the possibility does exist that there may be burrow holes in the embankment.

c. Appurtenant Structures

1. Spillway

The concrete spillway appears to be in good condition. There is severe spalling and deterioration of the right concrete pier of the wooden plank bridge. Exposed reinforcing steel was noticed at this pier. No surface or structural cracks were observed. Horizontal and vertical alignment of the spillway crest appeared good.

There is severe spalling of the apron along the downstream side of the right abutment. Voids exist between the apron's concrete and its underlying grouted rubble. Just beyond the apron there is heavy vegetation growing along the left side of the spillway channel. Minor erosion has exposed the top of the footing of the spillway channel's right wingwall. This minor erosion is located near the end of the wall.

2. Bridge and Piers

Two concrete abutments and two wooden "T" beams support a 4 foot wide wooden plank foot brige that spans the spillway. The "T" beams are in turn supported by two concrete piers which also hold the flashboards. The right pier has severe spalling and is deteriorating. The wooden bridge is in good condition.

3. Outlet Works

A concrete drop inlet with a steel plate cover, connected to an 18-inch reinforced concrete pipe through the dam serves as the low-level outlet works. Flow is controlled by manually removing a steel plate slide gate. A concrete headwall structure, supports the slide gate and inlet. At the headwall, there are two cracks along the back wall and one crack on the inside of the left wingwall. The discharge end of the outlet is in good condition. There is no headwall at the outlet's end. Water was flowing from the outlet, indicating that the inlet end is not water tight.

d. Reservoir Area

Houses, boat landings and trees circle the lake. The reservoir slopes vary from flat to steep. There is no indication of slope instability. The lake appeared clean. However, according to the owner some sedimentation accumulates at the lake's inflow end.

e. Downstream Channel

The downstream channel is in good condition. It crosses under the bituminous service road through two 48-inch reinforced concrete pipes approximately 150 feet from the spillway. The channel flow continues left from the road and parallel with the road to a point approximately 60 feet beyond the low-level outlet drain. Riprap is along the channel's right bank in this "parallel section". From the point beyond the low-level outlet the channel flow continues right or perpendicular to the road. There are two houses along the right bank, approximately 300 feet from the spillway. A swimming pool and tennis courts are along the channel's left bank. The swimming pool is just beyond the bituminous service road and the tennis courts are located beyond the pool.

SECTION 4

4. OPERATIONAL PROCEDURES

4.1 Procedures

Shadow Lake Dam is used to impound water for recreational activities. The level of the lake is maintained through the unregulated flow over the spillway's flashboards. The lake is lowered occasionally to allow property owners to make repairs to their properties, and to clean the lake bottom.

4.2 Maintenance of the Dam

There is no regular inspection and maintenance program for the dam and appurtenant structures. Shadow Lake, Inc. is responsible for the maintenance of the dam.

4.3 Maintenance of Operating Facilities

The low-level operating facilities consist of a 2 foot wide steel plate that is manually raised and lowered. At the time of inspection, the plate was not raised because there was no equipment available to lift it.

4.4 Evaluation

The present operational and maintenance procedures are good with the dam and spillway being maintained in a serviceable condition.

SECTION 5

5. HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design

The drainage area above Shadow Lake Dam is approximately 1.94 square miles. A drainage map of the watershed of Shadow Lake dam site is presented on Plate 1, Appendix D.

The topography within the basin is generally moderately sloped. Elevations range from approximately 555 feet above NGVD at the south end of the watershed to about 355 feet at the dam site. Land use patterns within the watershed are mostly woodland with residential development around the lakes and main roads.

The evaluation of the hydraulic and hydrologic features of Shadow Lake was based on criteria set forth in the Corps Guidelines and additional guidance provided by the Philadelphia District, Corps of Engineers. The SDF for the dam falls in a range of 100-year Flood to 1/2 PMF. In this case, the low end of the range, 100-year Flood, is chosen since the factors used to select size and hazard classification are on the low-side of their respective ranges.

The 100-year Flood was calculated from 100-year precipitation using National Weather Service Hydro - 35 and Technical Paper No. 40. Due to the small drainage area, the SCS triangular hydrograph transformed to a curvilinear hydrograph was adopted for developing the unit hydrograph, with the aid of the HEC-1DB Flood hydrograph Computer Program.

Initial and constant infiltration loss rates were applied to the 100-year rainfall to obtain rainfall excesses. The rainfall excesses were applied to the unit hydrograph to obtain the 100-year Flood hydrograph utilizing program HEC-1DB.

The SDF peak outflow calculated for the dam is 2,714 cfs. This value is derived from the 100-year flood, assuming that the lake was originally at flashboard crest elevation. The 100-year flood was routed through the dam and results in overtopping of the dam assuming that the lake was originally at spillway crest elevation.

The reservoir stage-storage capacity relationship was computed directly by the conic method, utilizing the HEC-1DB program. The reservoir surface areas at various elevations were measured by planimeter from U.S.G.S. Quadrangle topographic map. Reservoir storage capacity included surcharge levels exceeding the top of the dam, and the spillway rating curve was based on the assumption that the dam remains intact during routing. The spillway rating curve is presented in the Hydrologic Computations, Appendix D.

Drawdown calculations indicate that to empty the lake to an elevation of 349.3 NGVD through the one low-level sluice would take 10 days, assuming no inflow. This is considered to be an excessive drawdown period, and provision of additional outlets should be considered.

b. Experience Data

No records of reservoir stage or spillway discharge are maintained for this site.

c. Visual Observation

The downstream channel is well defined and in good condition. Riprap is along the channel's right bank in the section that parallels the service road.

Houses, boat landings and trees circle the lake. The slopes vary from flat to steep.

d. Overtopping Potential

A storm of magnitude equivalent to the SDF would cause overtopping of the dam to a height of 1.34 feet. Computations indicate that the dam can pass approximately 20 percent of the SDF (100-year storm) without overtopping the dam crest. Since the 100-year storm is the Spillway Design Flood (SDF) for this dam, according to the Recommended Guidelines for Safety Inspection of Dams by the Corps of Engineers, the spillway capacity of the dam is assessed as "inadequate".

SECTION 6

6. STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

There are no major distress signs in the embankment of Shadow Lake Dam. Trees growing on both the upstream and downstream slopes could pose a threat to stability. There are some cavities along the embankment crest behind the upstream grouted rubble wall. The spillway is in good condition except for the right bridge pier (and flashboard support) which is severely deteriorated.

b. Design and Construction Data

No design computations relating to stability were uncovered during the report preparation phase. No embankment or foundation soil parameters are available for carrying out a conventional stability analysis on the embankment.

c. Operating Records

No operating records are available relating to the stability of the dam.

d. Post-Construction Changes

The low-level outlet, embankment and the spillway have been modified. There is no information as to the dates of the modifications.

e. Static Stability

A static stability analysis was not performed for Shadow Lake Dam because the lack of data on which to base assumptions of material properties within the embankment zones might produce misleading results, but based on the findings of the visual inspection, the preliminary assessment of static stability is that it is satisfactory.

f. Seismic Stability

Shadow Lake Dam is located in Seismic Zone 1, as defined in Recommended Guidelines for Safety Inspection of Dams, prepared by the Corps of Engineers. In general, projects located in Seismic Zones 0, 1, and 2 may be assumed to present no hazard from earthquake, provided the static stability conditions are satisfactory and conventional safety margins exist and based on the findings of the visual inspection, the preliminary assessment of the static and seismic stabilities is that they are satisfactory.

SECTION 7

7. ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety

The dam has been inspected visually and a review has been made of the available engineering data. This assessment is subject to the limitations inherent in the visual inspection procedures stipulated by the Corps of Engineers for a Phase I report.

The adequacy of Shadow Lake Dam is considered questionable in view of its lack of spillway capacity to pass the 100-year flood, which is the SDF for the dam, without overtopping. The spillway is assessed as "inadequate".

No definitive statement pertaining to the safety of the embankment can be made without acquisition of embankment and foundation material engineering properties, but based on the findings of the visual inspection, the preliminary assessment of static stability is that it is satisfactory.

b. Adequacy of Information

The information uncovered was adequate to perform hydrologic and hydraulic computations. The data was insufficient to perform even an approximate computation of the stability of the dam. A preliminary assessment of the dam could be made by visual observation only.

c. Urgency

The remedial measures and recommended actions along with a timetable for their completion are detailed below. All recommended actions should be conducted under the supervision of an engineer who is experienced in the design, construction and inspection of dams.

7.2 Remedial Measures

a. Alternatives for Increasing Spillway Capacity

Alternatives for increasing spillway capacity are as follows:

1. Increase the embankment height of the dam thus permitting a higher discharge to pass over the spillway and reducing the possibility of overtopping.

2. Lower the spillway crest elevation.

3. Increase the effective spillway crest length.

4. A combination of any of the above alternatives.

b. Recommendations

1. Carry out a more precise hydrologic and hydraulic analysis of the dam within twelve months, to determine the need and type of mitigating measures necessary. If required, conduct a study of the means of increasing spillway discharge capacity and develop alternative schemes for construction. This should include the installation of headwater and tailwater gages. The ability of the dam to withstand overtopping should also be studied.

2. Conduct a complete topographic survey of the dam and surrounding area, in order to develop a detailed plan and several cross-sections of the dam within twenty-four months.

3. Repair spalled concrete pier and the cracks in the concrete headwall of the low-level outlet within twelve months.

4. Fill in the voids between the bottom of the concrete apron and the supporting rubble wall at the bottom of the channel. This should be completed within twelve months.

5. Provide a concrete headwall and apron at the discharge end of the low-level outlet. This work should be completed within twelve months.

6. Remove all vegetation from the bottom of the discharge channel and fill in the voids along the right retaining wall, within twelve months.

7. Fill in and reseed the eroded areas along the embankment crest. This work should be started within twelve months.

8. Investigate the embankment for animal burrows and fill in any burrow holes with impervious material.

9. All brush and trees should be removed from the downstream and upstream slopes to avoid problems which may develop from roots. The embankment face should then be seeded to develop a growth of grass for surface erosion protection. This program should be started within twelve months.

The following additional actions are recommended:

1. The owner should develop an emergency action plan (if one is not already available) outlining actions to be taken by the operator to minimize downstream effects of an emergency and establish a flood warning system for the downstream communities within three months.

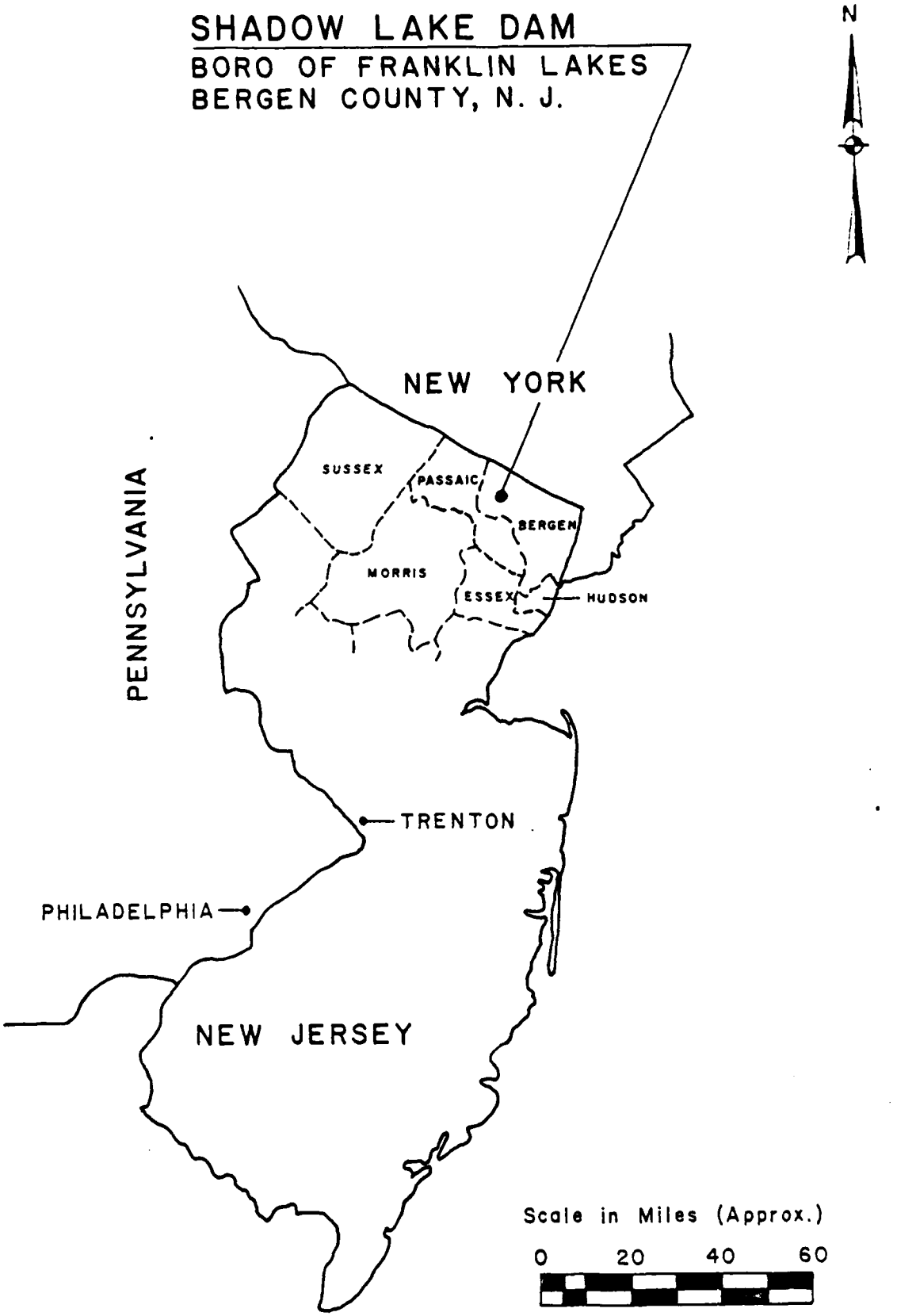
2. Consider providing additonal low-level outlet facilities, to decrease drawdown time.

c. O & M Procedures

The owner should develop, within one (1) year after formal approval of the report, written operating procedures and a periodic maintenance plan to insure the safety of the dam.

PLATES

SHADOW LAKE DAM
BORO OF FRANKLIN LAKES
BERGEN COUNTY, N. J.

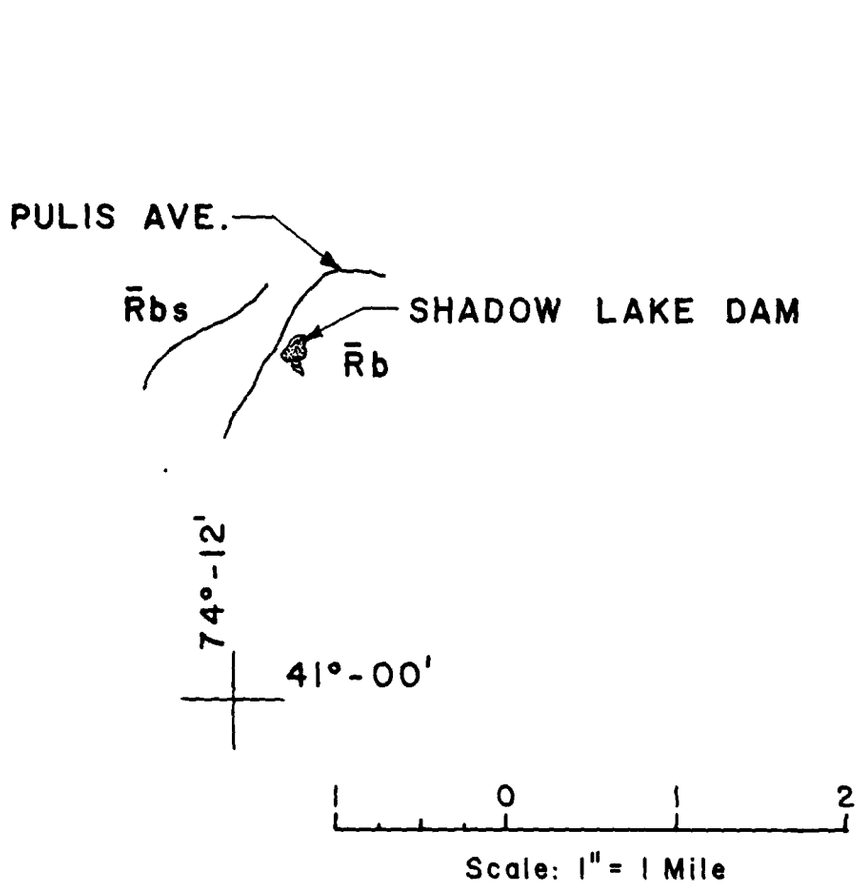


KEY MAP

PLATE I

VICINITY MAP

PLATE IA



LEGEND:

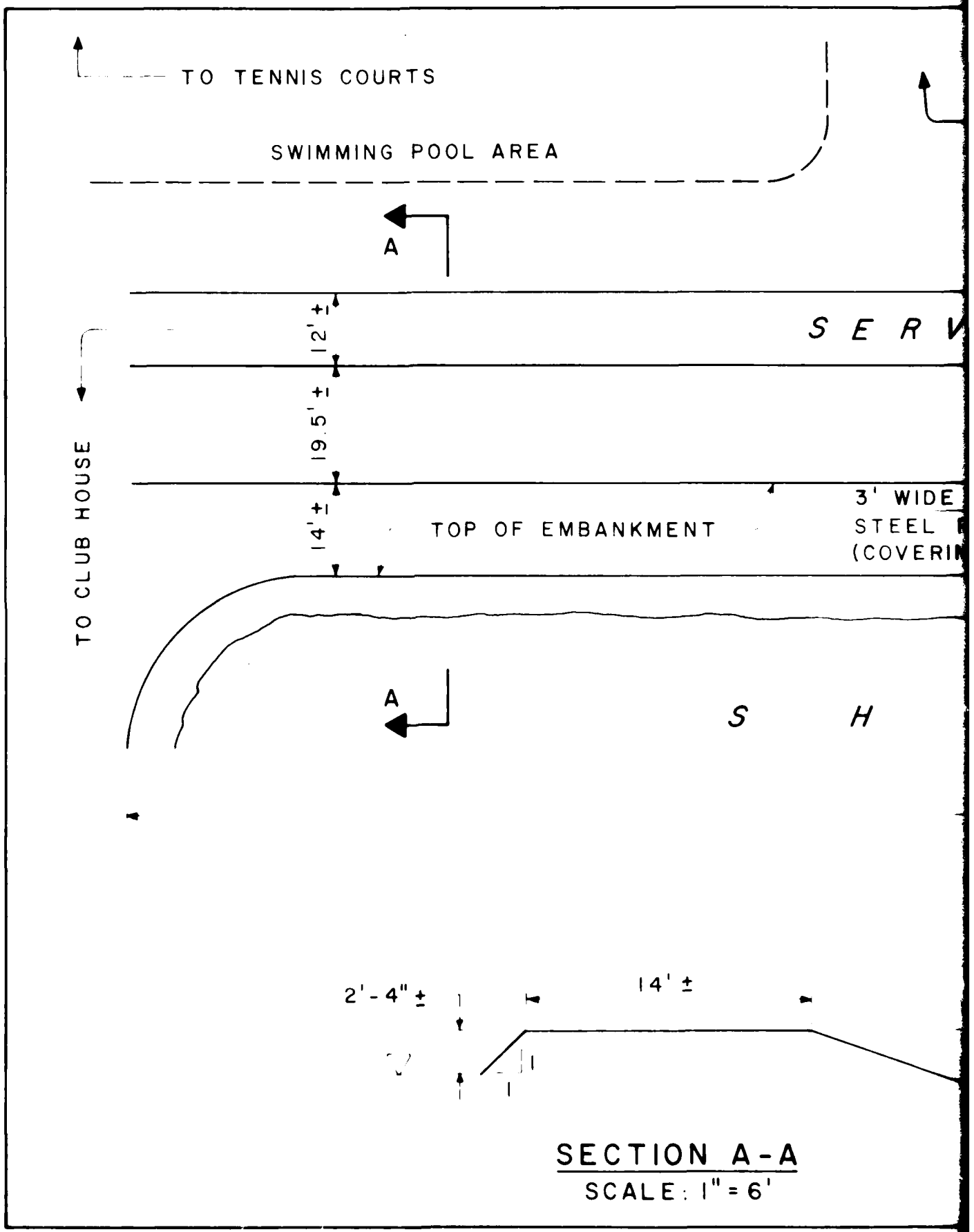
TRIASSIC

R̄b Brunswick Formation.

R̄bs Basalt Flows.

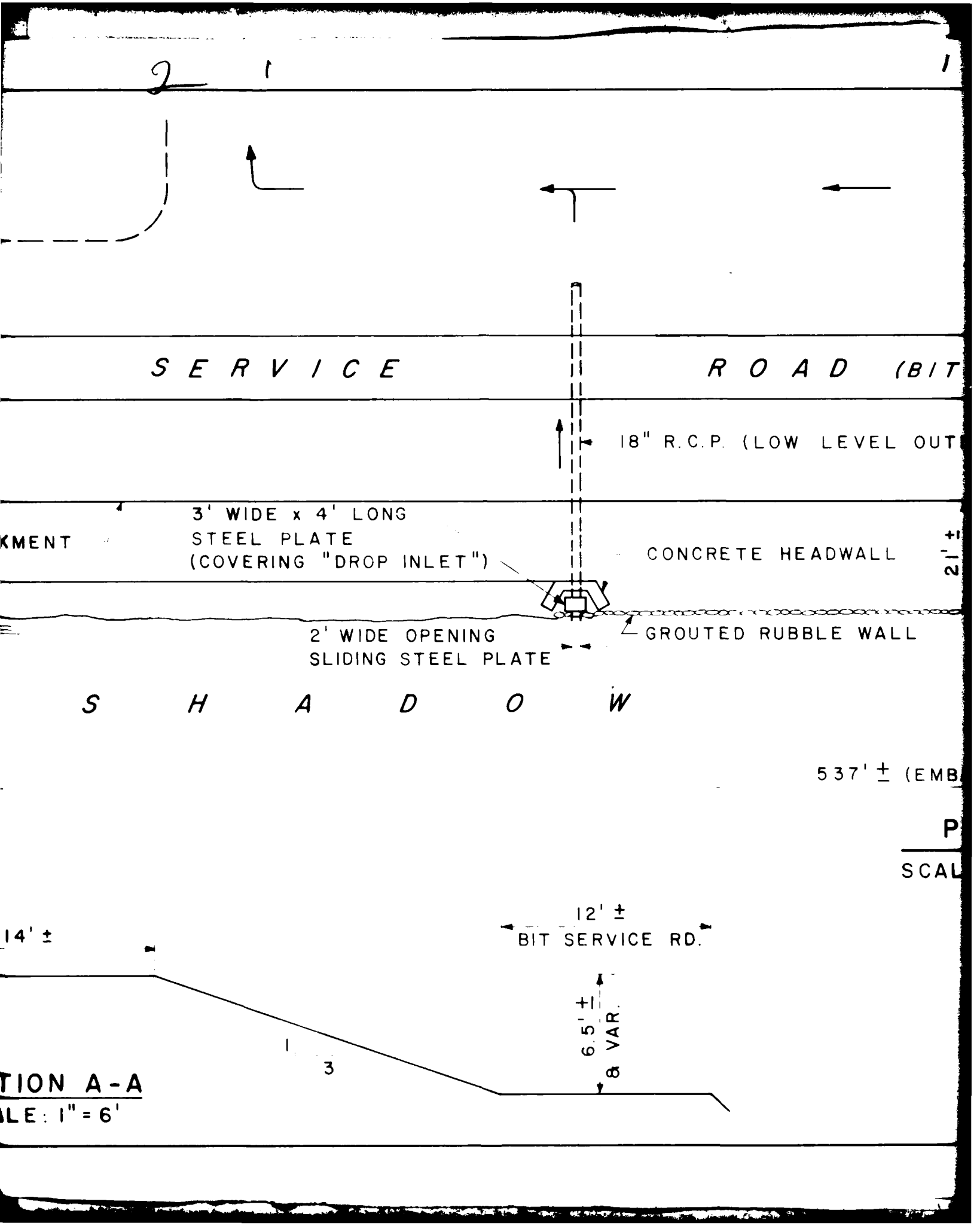
GEOLOGIC MAP
SHADOW LAKE DAM

PLATE 2



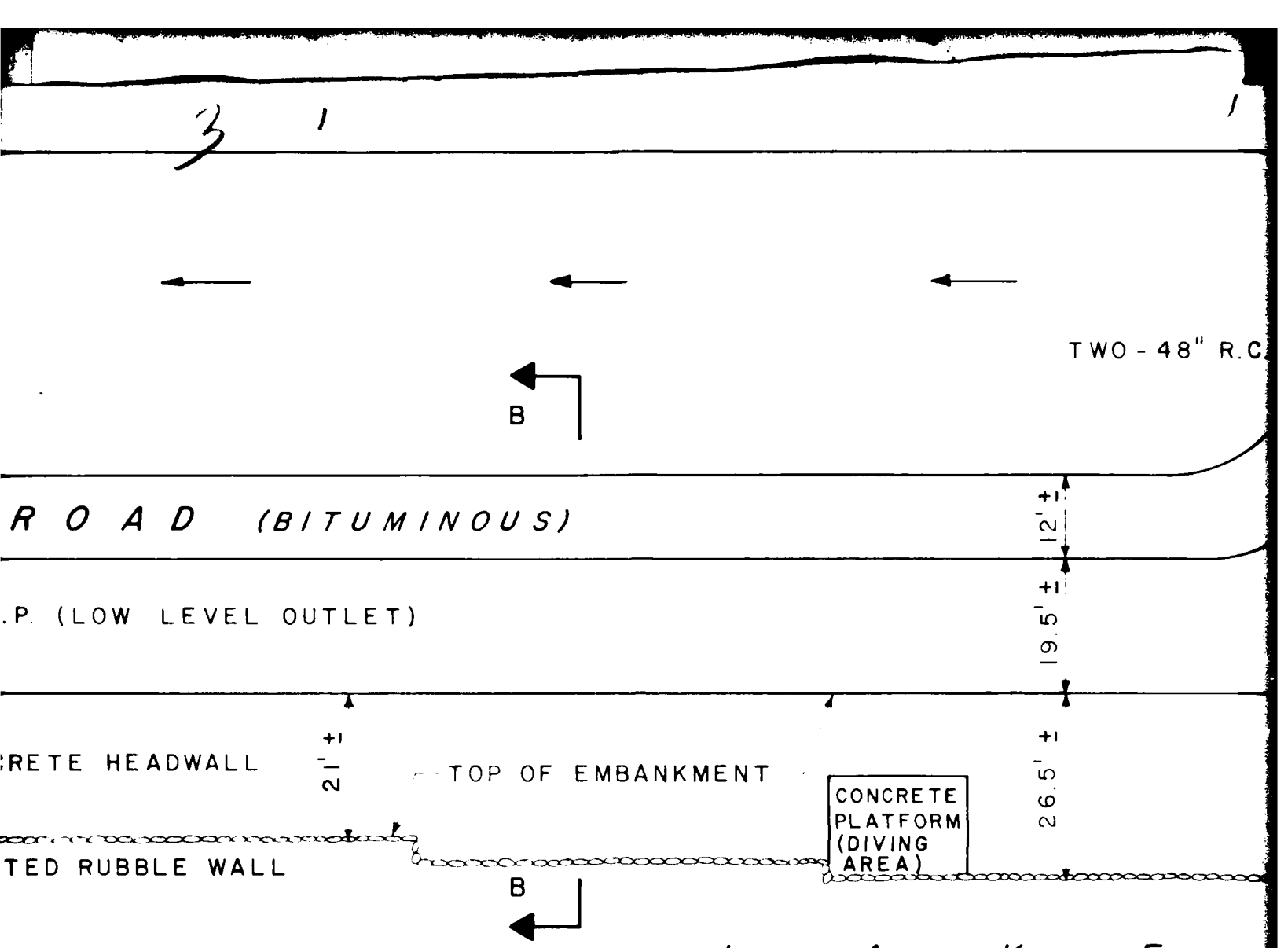
SECTION A-A

SCALE: 1" = 6'


2
1
1
SERVICE
ROAD (BIT
18" R.C.P. (LOW LEVEL OUT
3' WIDE x 4' LONG
STEEL PLATE
(COVERING "DROP INLET")
CONCRETE HEADWALL
2' WIDE OPENING
SLIDING STEEL PLATE
GROUTED RUBBLE WALL
S H A D O W
537' ± (EMB
P
SCAL
14' ±
12' ±
BIT SERVICE RD.
6.5' ±
VAR.
1
3

TION A-A

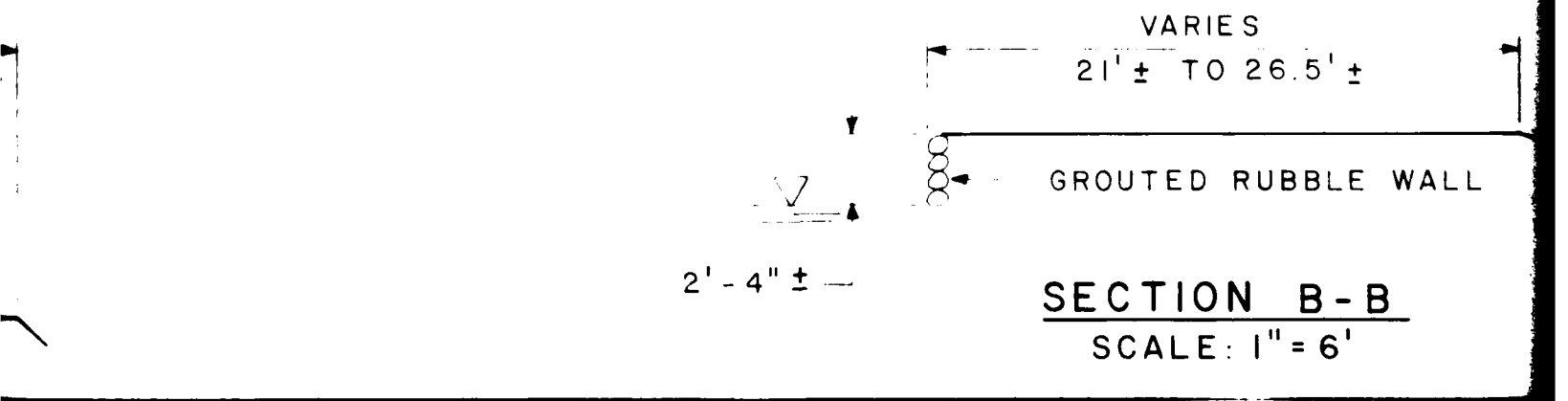
LE: 1" = 6'



537' ± (EMBANKMENT)

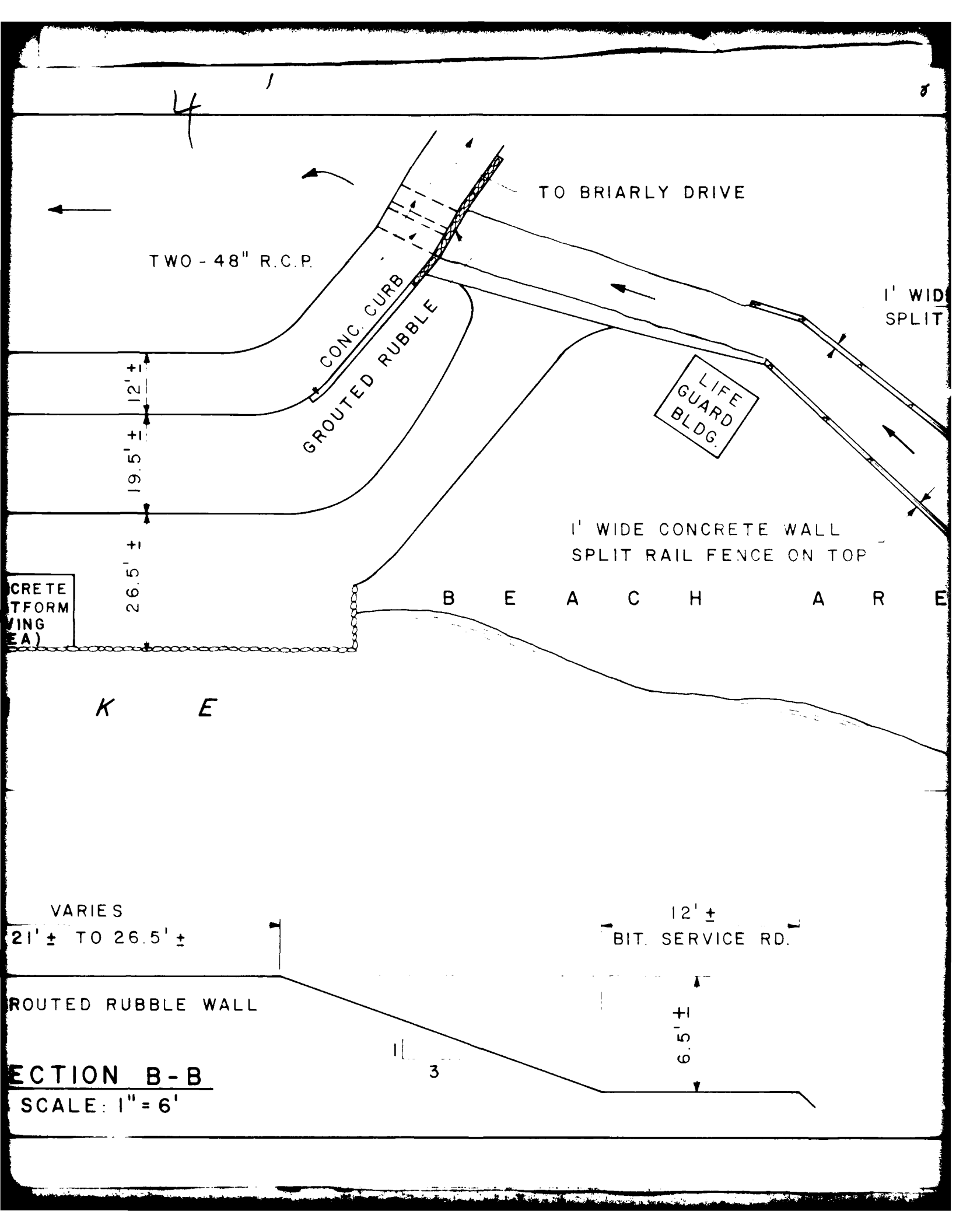
PLAN

SCALE: 1" = 20'



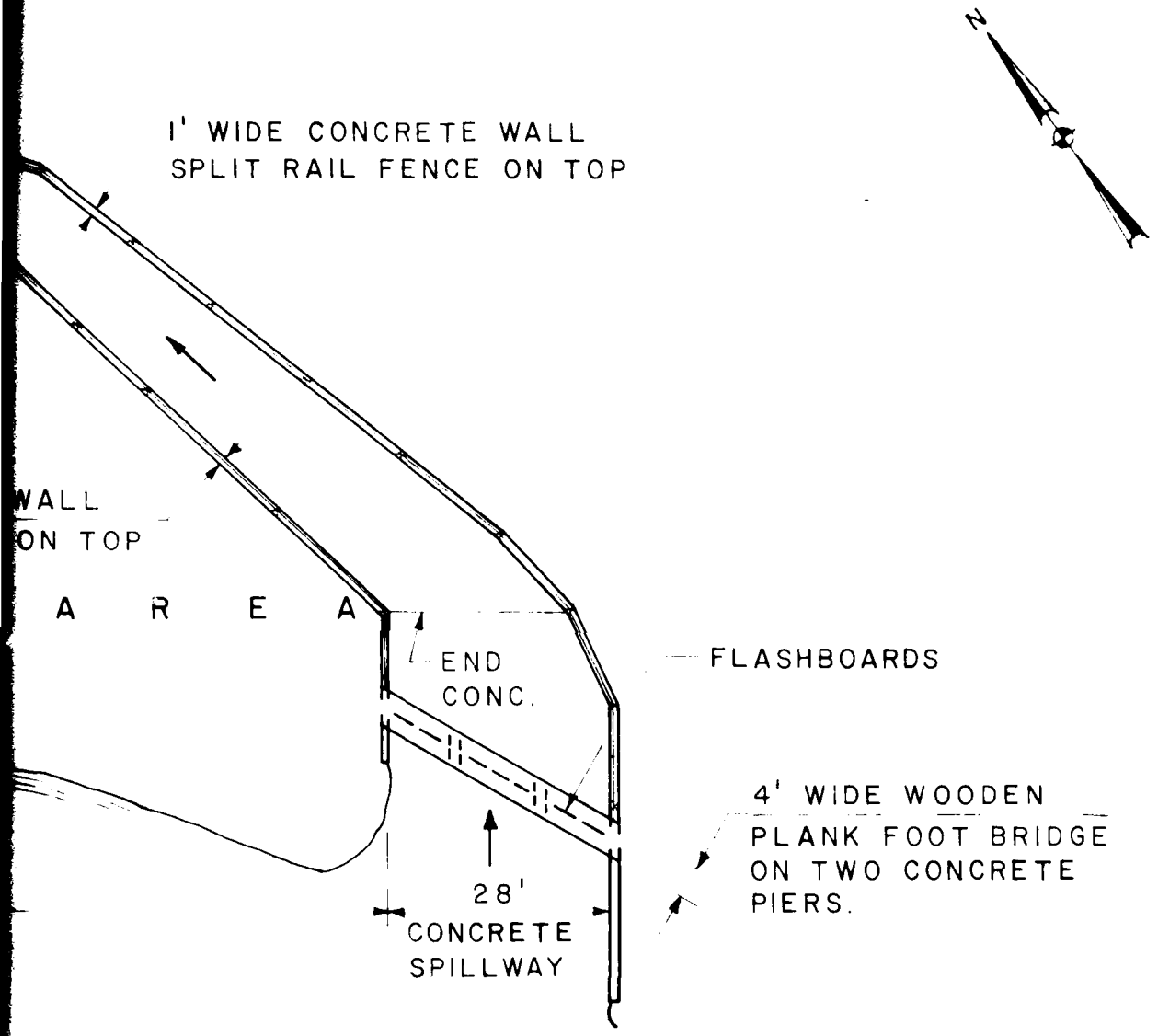
SECTION B-B

SCALE: 1" = 6'



ECTION B-B

SCALE: 1" = 6'



SHADOW LAKE DAM

BORO OF FRANKLIN LAKES, BERGEN COUNTY, N.J.

SKETCHES OF PLAN AND SECTIONS
PREPARED FROM FIELD NOTES TAKEN
DURING INSPECTION ON NOV. 27, 1979

BY:
HARRIS - ECI ASSOCIATES
WOODBRIDGE, NEW JERSEY

SCALE: AS SHOWN
DATE: FEB. 22, 1980
SHEET: 1 OF 1

PLATE 3

APPENDIX A

CHECK LIST - VISUAL OBSERVATIONS

CHECK LIST - ENGINEERING, CONSTRUCTION MAINTENANCE DATA

CHECK LIST
VISUAL INSPECTION

PHASE 1

Name Dam SHADOW LAKE DAM County Bergen State New Jersey Coordinators NJ-DEP

Date(s) Inspection November 26, 1979
November 27, 1979 Weather Rain
Clear Temperature 50°F
58°F

Pool Elevation at Time of Inspection 354 NGVD Tailwater at Time of Inspection 347 NGVD

Inspection Personnel:

November 26 and 27, 1979

Chuck Chin
Henry King (Recorder)
Thomas Lakovich

November 26, 1979

John Talerico

OWNER/REPRESENTATIVE:

November 26, 1979

Albert B. Fisher, Jr.
Shadow Lake, Inc.
230 Arbor Road
Franklin Lakes, NJ 07417

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SEEPAGE OR LEAKAGE N/A		
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS N/A		
DRAINS N/A		
WATER PASSAGES N/A		
FOUNDATIONS N/A		

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES N/A		
STRUCTURAL CRACKING N/A		
VERTICAL & HORIZONTAL ALIGNMENT N/A		
MONOLITH JOINTS N/A		
CONSTRUCTION JOINTS N/A		

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SURFACE CRACKS	None noticed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None noticed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Minor erosion at 2 downstream locations. Erosion caused by these locations being used as footpaths. Some cavities behind the grouted rubble wall. Minor erosion along back of right retaining wall (at discharge channel).	Refill eroded areas with appropriate materials and reseed areas.
VERTICAL & HORIZONTAL ALIGNMENT OF THE CREST	Horizontal alignment good. Appears to be some areas of minor vertical misalignment along upstream crest.	
RIPRAP FAILURES	None	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
EARTH EMBANKMENT	Has birch trees growing along upstream side left of the low-level outlet and along the entire downstream side. Additionally, large evergreen trees are growing along the downstream side between the low-level outlet and the beach.	Remove trees.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good condition, no differential settlement was noticed.	
ANY NOTICEABLE SEEPAGE	None noticed on dam slope, on roadway or on roadway slopes.	
STAFF GAGE AND RECORDER	None	
DRAINS	None	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CRACKING & SPALLING OF CONCRETE SURFACES IN STILLING BASIN N/A		
INTAKE STRUCTURE Intake consisting of steel plate slide gate and "drop inlet". Concrete supporting headwall structure with wingwalls. There are two vertical cracks along the backwall and one vertical crack on the left wingwall of the headwall structure.		Repair cracks .
OUTLET STRUCTURE Low-level drain (18-inch reinforced concrete pipe) discharges directly into downstream channel. Pipe has no headwall or apron. Pipe in good condition. Gate was not raised due to lack of equipment to lift it.		Provide concrete headwall and apron for pipe.
OUTLET FACILITIES None		
EMERGENCY GATE None		

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONCRETE WEIR	Slight spalling along upstream edge of weir. Flashboards, totaling 12-inches in height, were in place. Boards are in good condition.	
APPROACH CHANNEL	Reservoir	
DISCHARGE CHANNEL	Spalling of the apron along the right abutment. At the end of the concrete apron there are voids between the bottom of the concrete and the supporting grouted rubble wall at the bottom of the channel. Beyond the concrete portion of the channel there is heavy vegetation growing along the left side of the channel. The right side of the channel has minor erosion exposing the top of the retaining wall's footing.	Fill in voids between concrete and rubble wall with grout. Remove all vegetation from channel bottom. Fill in the voids in channel bottom along the right wall.
BRIDGE AND PIERS	The wooden plank bridge is in good condition. The right concrete pier, which also holds the flashboards in place, is badly deteriorated exposing the reinforcing steel.	Repair the pier with epoxy concrete.

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONCRETE SILL N/A		
APPROACH CHANNEL N/A		
DISCHARGE CHANNEL N/A		
BRIDGE AND PIERS N/A		
GATES & OPERATION EQUIPMENT N/A		

VISUAL EXAMINATION OF	INSTRUMENTATION OBSERVATIONS	REMARKS AND RECOMMENDATIONS
MONUMENTATION/SURVEYS None		
OBSERVATION WELLS None		
WEIRS None		
PIEZOMETERS None		
OTHER None		

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SLOPES	The slopes vary from flat to steep. There is no indication of slope instability.	
SEDIMENTATION	None noticed. According to the owner, some sedimentation accumulates at the lake's inflow end.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONDITION (OBSTRUCTION, DEBRIS, ETC.)	The channel crosses under the bituminous service road through two 48-inch reinforced concrete pipes approximately 150 feet from the spillway. The channel flows parallel with the road to a point about 60 feet beyond the low level outlet drain where it veers right. The channel is in good condition. Riprap lies along its right bank.	
SLOPES	Slopes are 2H. to 1V. and covered with brush and trees.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	Two homes along right bank and swimming pool and tennis courts along left bank of channel. The two homes are not in the flood plain.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	WPA NEW JERSEY plan entitled "Riparian and Stream Survey" dated 1-14-37 obtained from Boswell Engineering Co., Ridgefield Park, NJ appears to show dam and downstream channel as it existed at that time. No other plans available.
REGIONAL VICINITY MAP	Available--Bergen County Map and U.S.G.S. Quadrangle Sheet for Ramsey, New Jersey - New York.
CONSTRUCTION HISTORY	According to the owner the spillway was modified in 1957.
TYPICAL SECTIONS OF DAM	None available.
HYDROLOGIC/HYDRAULIC DATA	None available.
OUTLETS - PLAN	None available.
- DETAILS	None available
- CONSTRAINTS	None
- DISCHARGE RATINGS	None available.
RAINFALL / RESERVOIR RECORDS	None available.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
(continued)

ITEM	REMARKS
DESIGN REPORTS	None available.
GEOLOGY REPORTS	Available U.S.G.S. Geologic Overlay Sheet for Bergen County and Engineering Soils Survey of New Jersey, Report No.4 - Bergen and Hudson Counties, by Rutgers University.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None available.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None available.
POST-CONSTRUCTION SURVEYS OF DAM	None
BORROW SOURCES	Unknown.
SPILLWAY PLAN - SECTIONS - DETAILS	None

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
(continued)

ITEM	REMARKS
OPERATING EQUIPMENT PLANS AND DETAILS	None available.
MONITORING SYSTEMS	None available.
MODIFICATIONS	Spillway modified in 1957 (according to owner).
HIGH POOL RECORDS	Not kept.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Existing condition report, July 28, 1968
PRIOR ACCIDENTS OF FAILURE OF DAM - DESCRIPTION - REPORTS	None known to exist.
MAINTENANCE OPERATION RECORDS	None known to exist.

APPENDIX B

PHOTOGRAPHS

(Taken on November 27, 1979 and February 8, 1980)

Photo 1 - View of embankment toward right edge of dam. Portion of bituminous service road, at foot of downstream slope, is visible at left. (Photo taken on February 8, 1980).

Photo 2 - View of downstream side of the embankment, toward right edge of dam, and the service road at the foot of the embankment. Swimming pool is out of photo to viewer's left. (Photo taken on February 8, 1980).

Photo 3 - View from left edge of dam toward reservoir upstream. (Photo taken on November 27, 1979).

Photo 4 - View toward beach area, just beyond bridge, and the left edge of dam at left. (Photo taken on November 27, 1979).

Photo 5 - View from diving area toward the low-level outlet and left edge of dam. Club house is at left center. (Photo taken on November 27, 1979).

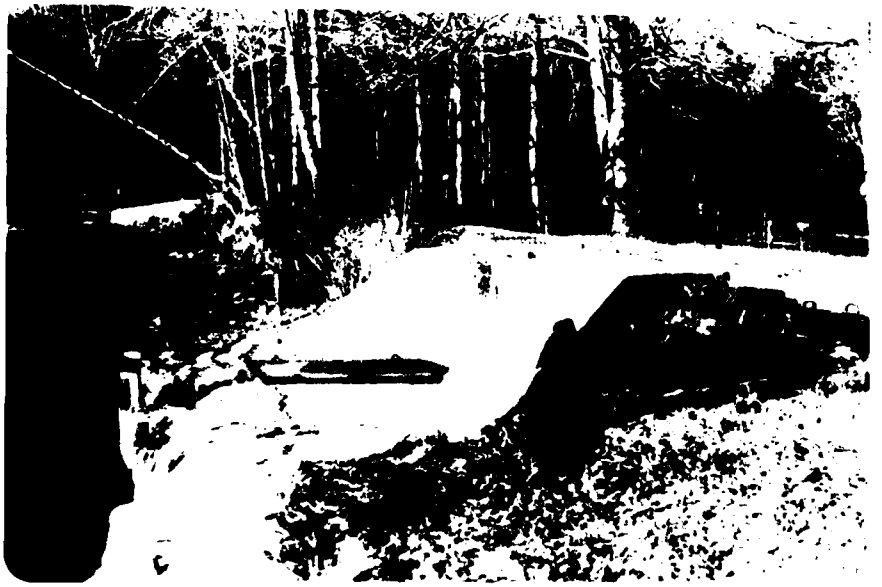


Photo 6 - View toward the low-level outlet and left edge of dam. Steel plate covers drop inlet opening. (Photo taken on November 27, 1979).

Photo 7 - Detail of the upstream low-level outlet mentioned in photos 5 and 6. Steel plate at right is cover for the drop inlet. In center of photo is sliding steel plate. (Photo taken on November 27, 1979).

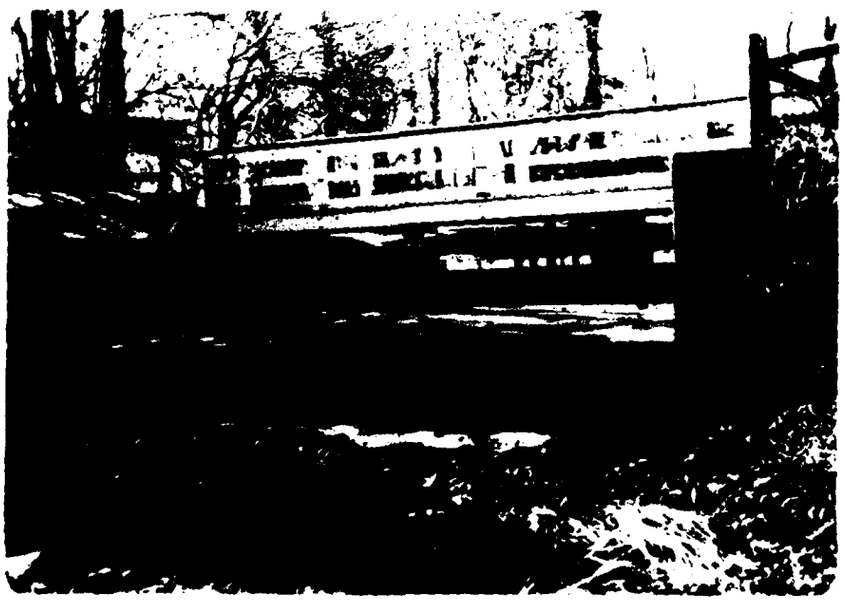


Photo 8 - View of spillway from downstream. (Photo taken on November 27, 1979).

Photo 9 - Detail of right concrete pier from upstream side of spillway. Note exposed reinforcing steel bar in deteriorated concrete pier. (Photo taken on November 27, 1979).

Photo 10 - View, from upstream, of the spillway discharge channel. Note heavy vegetation growing on left side of channel and the minor erosion at base of the right wall. A portion of the life guard building is shown at upper left. (Photo taken November 27, 1979).

Photo 11 - View, from spillway discharge channel, looking down stream towards two 48-inch diameter reinforced concrete pipes under the service road. (Photo taken on November 27, 1979).

Photo 12 - View of downstream channel, from the low level outlet drain, towards the two 48-inch reinforced concrete pipes mentioned above in photo 11. (Photo taken on November 27, 1979).

Photo 13 - Detail of the downstream low level outlet drain - an 18-inch diameter reinforced concrete pipe. (Photo taken on November 27, 1979).

Photo 14 - View of the downstream channel from the embankment. Service road is visible across bottom of photo. At upper left of photo is portion of swimming pool. (Photo taken on November 27, 1979).

APPENDIX C

SUMMARY OF ENGINEERING DATA

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

Name of Dam: SHADOW LAKE DAM

Drainage Area Characteristics: 1.94 square miles

Elevation Top Normal Pool (Storage Capacity): 355 NGVD (75 acre-feet)

Elevation Top Flood Control Pool (Storage Capacity): N/A

Elevation Maximum Design Pool: 358.25 NGVD (SDF pool: 155 acre-feet)

Elevation Top Dam: 356.91 NGVD (119 acre-feet)

SPILLWAY CREST:

a. Elevation Concrete Weir 354 NGVD, Flashboards 355 NGVD

b. Type Concrete broad crested weir with flashboard

c. Width 18 feet

d. Length 28 feet

e. Location Spillover Entire spillway

f. No. and Type of Gates None

OUTLET WORKS:

a. Type 18-inch reinforced concrete pipe

b. Location 347 feet left of spillway

c. Entrance Inverts 349.23 NGVD

d. Exit Inverts 346.94 NGVD

e. Emergency Draindown Facilities Steel plate gate 18-inch dia. R.C.P.

HYDROMETEOROLOGICAL GAGES:

a. Type None

b. Location None

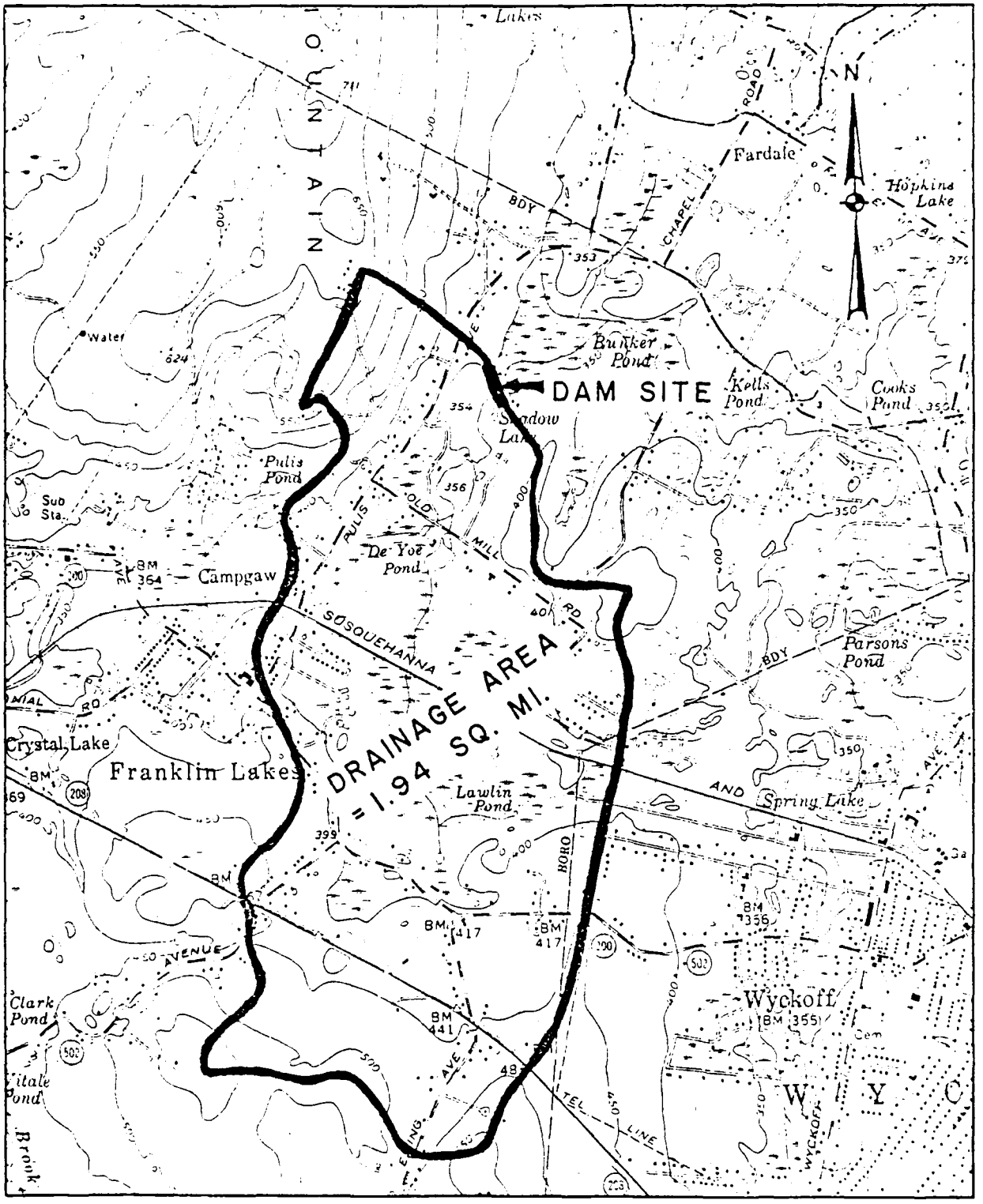
c. Records None

MAXIMUM NON-DAMAGING DISCHARGE: 213 cfs at elevation 356.91 NGVD

APPENDIX D

HYDROLOGIC COMPUTATIONS

PLATE I, APPENDIX D



SHADOW LAKE DAM
DRAINAGE BASIN

PRC Harris, Inc.
CONSULTING ENGINEERS

SUBJECT NJ Dam Safety Insp. Group XVII — Shadow Lake
COMPUTED BY BK CHECKED BY C.C. DATE 2/7/80
SHEET NO. 1 OF 11
JOB NO. 12-183-01

SHADOW LAKE DAM (NJ 00232)

SIZE CLASSIFICATION

Main Impoundment Surface Area	18.4 Acre
Average depth of Lake	6 Ft ±
Structural Height of Dam	10 Ft
Size classification	Small

HAZARD POTENTIAL CLASSIFICATION

- Recreation Area Located just immediately D/S of Dam & moderate travelled highway approx. 2500' D/S of Dam.

Hazard Potential	Significant
Recommened SDF	100-Yrs

HYDROLOGIC ANALYSIS

Flooding Routing will be computed by HEC-1DB Computer Program using SCS Triangular unit hydrograph with Curvilinear Transformation

D.A = 1.94 Sq. Mi.

Elevation - Area - capacity Relationship

Elev. (ft)	345*	354	360
Surface (Ac)	0	18.4	32.1

* Estimated bottom Elev. of Lake at Spillway

HEC-1 DB computer program will develop Storage-capacity relationship from the data of Elev. of surface areas.

Infiltration Data

Drainage Area consists of most of GS 24 & some GK

Hydrologic soil Group	C/B
Use initial infiltration	1.0 inch
Use constant infiltration	0.1 in/hr

Ref. Engineering Soil Survey of NJ Report #4
Bergen & Hudson Counties, Rutgers University, 1952

FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

SUBJECT NJ Dam Safety Insp. Prog. VII
SHADOW LAKE DAM
COMPUTED BY BK CHECKED BY [illegible]

SHEET NO 3 OF 11
JOB NO 10-11-83-01
DATE 2/7/80

TIME OF CONCENTRATION

1) From Velocity & Water Course Length

	Slope (%)	Vel. (fps)	Remark
Overland Flow	$\frac{555-385}{4200} = 4\%$	2	Upper watershed Woodland
Channel Flow	$\frac{385-356}{5400} = 0.54\%$	1	

$t_c = (4200/2 + 5400/1)/3600 = 2.1$ HRS.

2) From: Nomograph Diagram, "Design of Small Dam" p. 71

$\Delta H = 555 - 356 = 199$ $\quad L = 9600'$

$S = 199/9600 = 2.1\%$

$t_c = 0.65$ HR.

3) Using FAH Formula for Surface Flow (Airport Drainage)

$$T_c = \frac{1.8(1.1-C)\sqrt{D}}{\sqrt[3]{S}} = \frac{1.8(1.1-0.3)\sqrt{9600}}{\sqrt[3]{2.1}(60)} = 1.89 \text{ HRS.}$$

PRC Harris, Inc.
CONSULTING ENGINEERS

SUBJECT NJ Dam Safety program
Stadacona Lake
COMPUTED BY EK CHECKED BY CC

SHEET NO. 4 OF 11
JOB NO. 10-A83-01
DATE 4/17/80

4, G. B. Williams Flood Committee

$$t = 0.908\, L \sqrt[5]{\frac{1}{FD}}$$

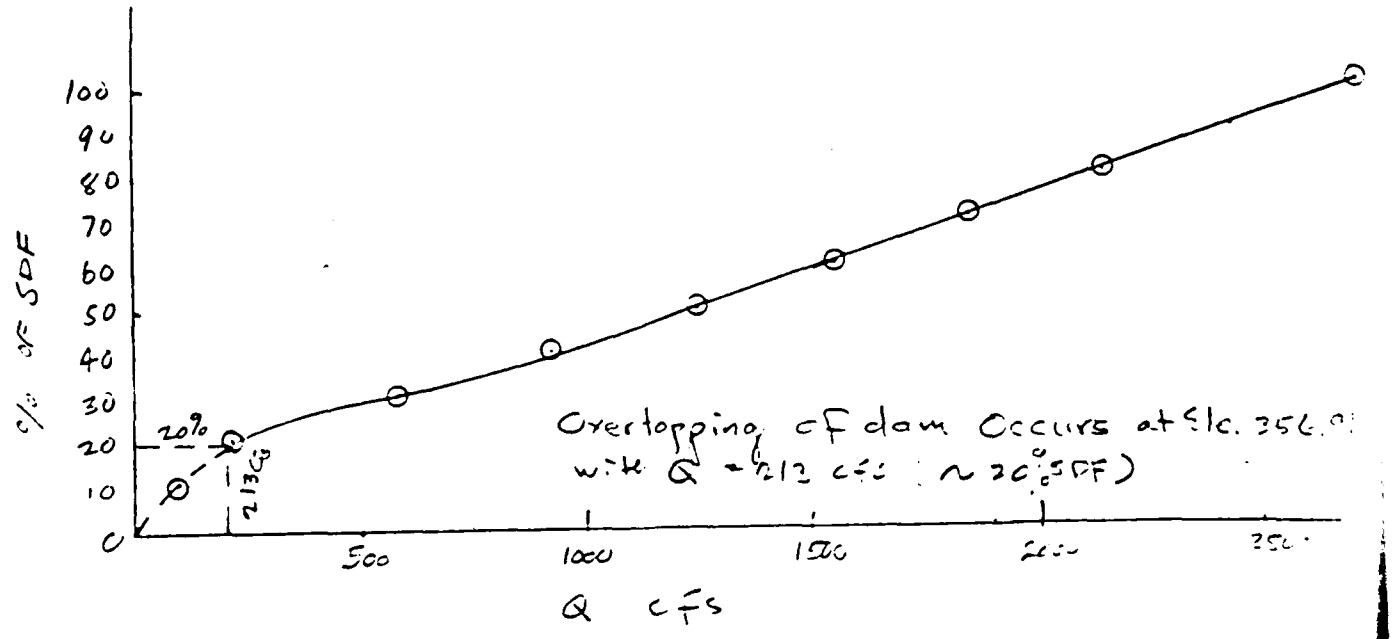
Where t = The period in hr.
L = the Length of the catchment in Miles
D = the diameter in miles of a circle having the same area
F = the catchment slope expressed in %

$$t = 0.908 \left(\frac{9600}{5280}\right) \sqrt[5]{\frac{1}{2.07 \times 1.13}} = 1.39 \text{ hr}$$

Use $t_c = 1.50$ hr

$L_{ag} = 0.6 \times 1.5 = 0.90$ hr

Overtopping Potential



PRC Harris, Inc.
CONSULTING ENGINEERS

SUBJECT NJ Dam Invent. Prog. Group INT
Shadow Lake
COMPUTED BY FK CHECKED BY CC

SHEET NO. 5 5 or 11
JOB NO. 1C.A83-01
DATE 3/9/80

Precipitation frequency values (inches) of 100 Yr for

5	min	0.77
10	min	(1.28)
15	min	1.64
30	min	(2.35)
60	min	3.05
2	hr	3.88
3	hr	4.35
4	hr	4.73
5	hr	4.98
6	hr	5.20

Ref. NOAA Tech. Mem. NWS HYDRO-35
Circled values obtained by plotting.

Ref. TP NO. 40

Shadow Lake

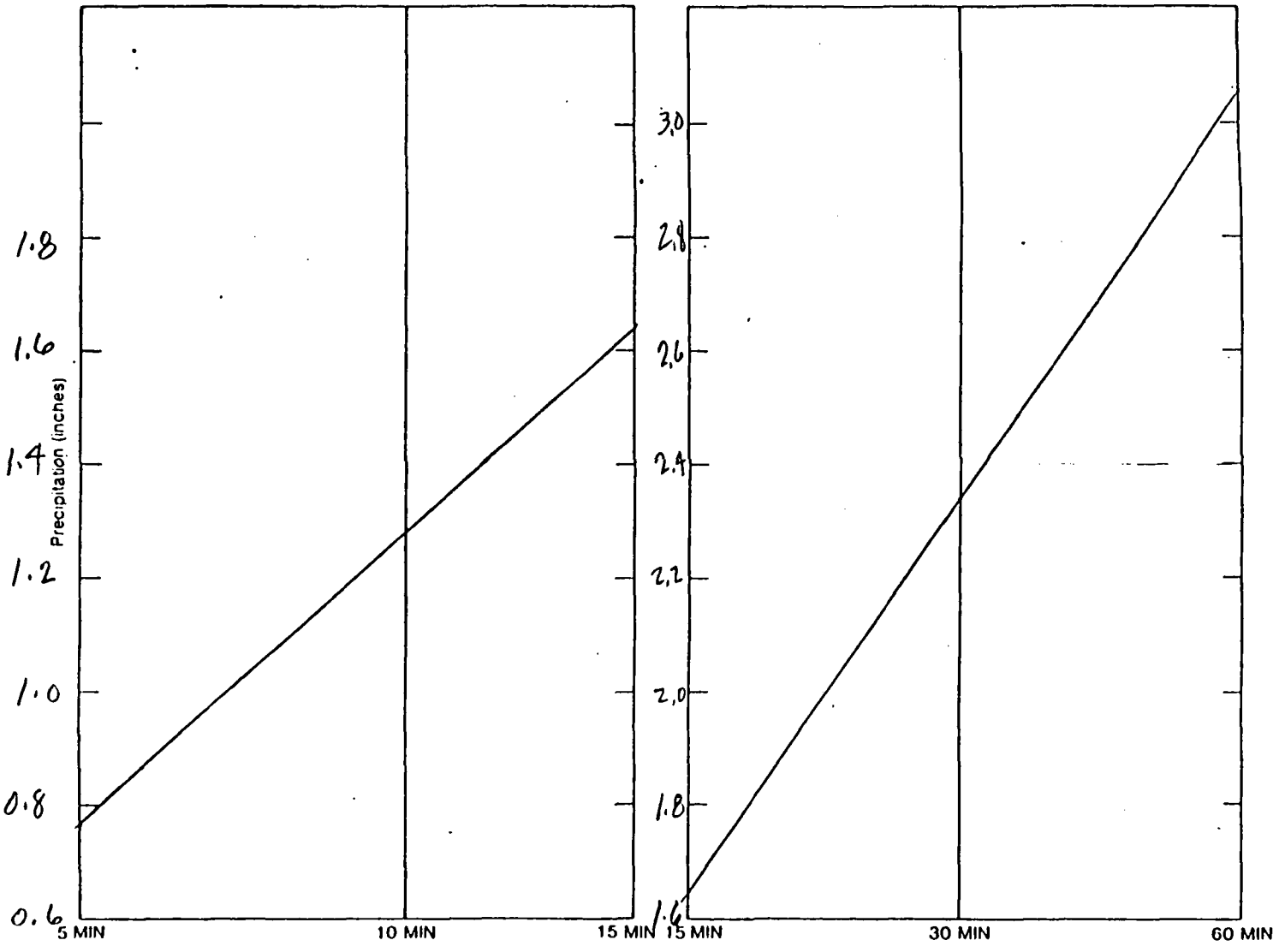


Figure 10.--Duration-interpolation diagram for 10- and 30-min estimates.

6 35 11

PRC Harris, Inc.

CONSULTING ENGINEERS

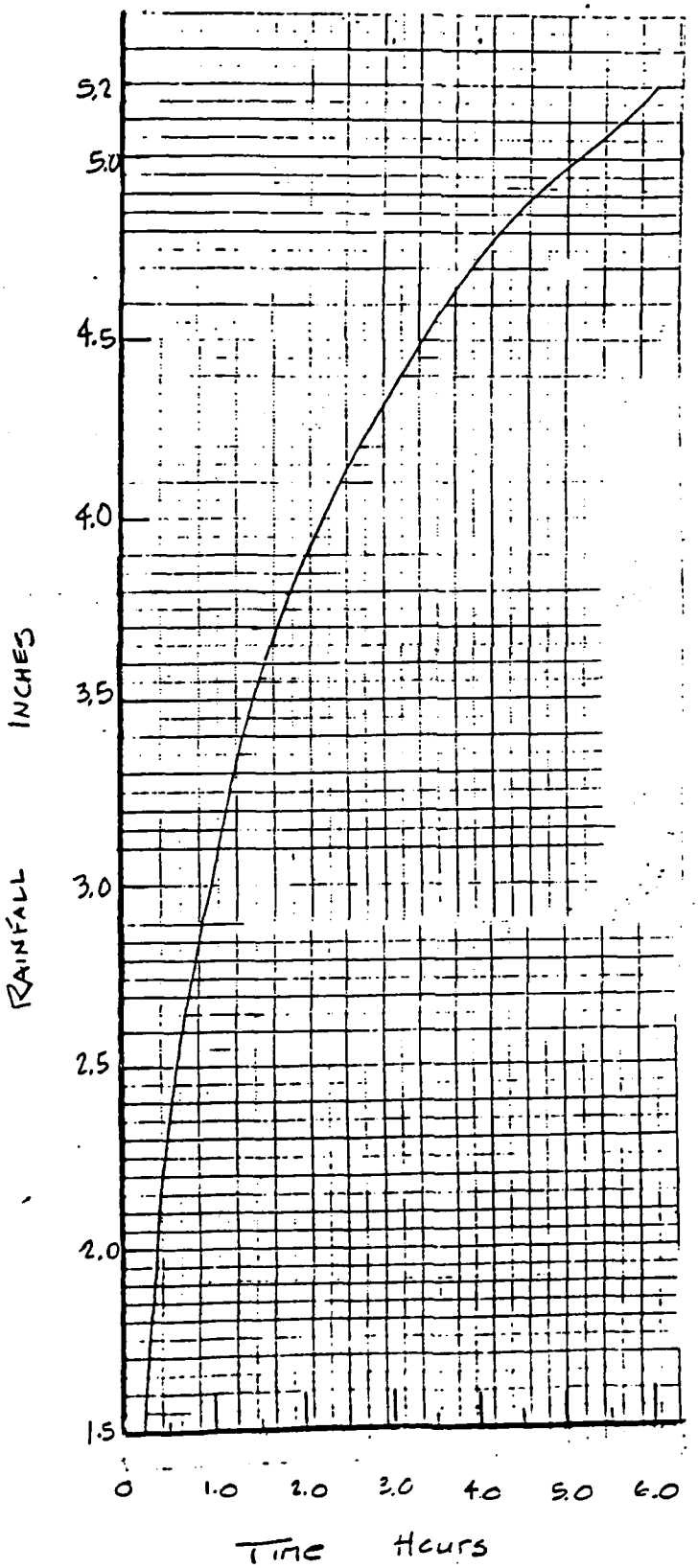
SUBJECT NJ Dam Safety Program Group IVE
SHADOW Lake

COMPUTED BY E.K. CHECKED BY C.G.

SHEET NO. 7 OF 11

JOB NO. 10-A83-01

DATE 4/1/80



PRC Harris, Inc.
CONSULTING ENGINEERS

SUBJECT NJ Dam Safety Prog. Group XVII Shadow Lake
SHEET NO. 8 OF 11
JOB NO. 10-A83-01
COMPUTED BY EK CHECKED BY C.C. DATE 4/17/80

100 - Yr. Rainfall Distribution (5 Min. interval)

Time Min	Total depth (d) in	Δd in	Time Min	Total depth in	Δd	Time min	Total depth in	Δd in
5	0.77	0.77	160	4.21	0.04	315	5.03	0.02
10	1.28	0.51	165	4.25	0.04	320	5.05	0.02
15	1.64	0.36	170	4.29	0.04	325	5.06	0.01
20	1.93	0.29	175	4.32	0.03	330	5.08	0.02
25	2.16	0.23	3hr 180	4.35	0.03	335	5.10	0.02
30	2.35	0.19	185	4.38	0.03	340	5.12	0.02
35	2.50	0.15	190	4.42	0.04	345	5.13	0.01
40	2.63	0.13	195	4.45	0.03	350	5.15	0.02
45	2.75	0.12	200	4.48	0.03	355	5.18	0.03
50	2.86	0.11	205	4.51	0.03	360	5.20	0.02
55	2.96	0.10	210	4.54	0.03			
1hr 60	3.05	0.09	215	4.58	0.04			
65	3.15	0.10	220	4.61	0.03			
70	3.25	0.10	225	4.64	0.03			
75	3.33	0.08	230	4.67	0.03			
80	3.42	0.09	235	4.70	0.03			
85	3.50	0.08	4hr 240	4.73	0.03			
90	3.58	0.07	245	4.75	0.02			
95	3.62	0.05	250	4.78	0.03			
100	3.67	0.05	255	4.80	0.02			
105	3.73	0.06	260	4.82	0.02			
110	3.78	0.05	265	4.84	0.02			
115	3.83	0.05	270	4.87	0.03			
2hr 120	3.88	0.05	275	4.89	0.02			
125	3.93	0.05	280	4.91	0.02			
130	3.97	0.04	285	4.93	0.02			
135	4.01	0.04	290	4.94	0.01			
140	4.05	0.04	295	4.96	0.02			
145	4.09	0.04	5hr 300	4.98	0.02			
150	4.13	0.04	305	4.99	0.01			
155	4.17	0.04	310	5.01	0.02			

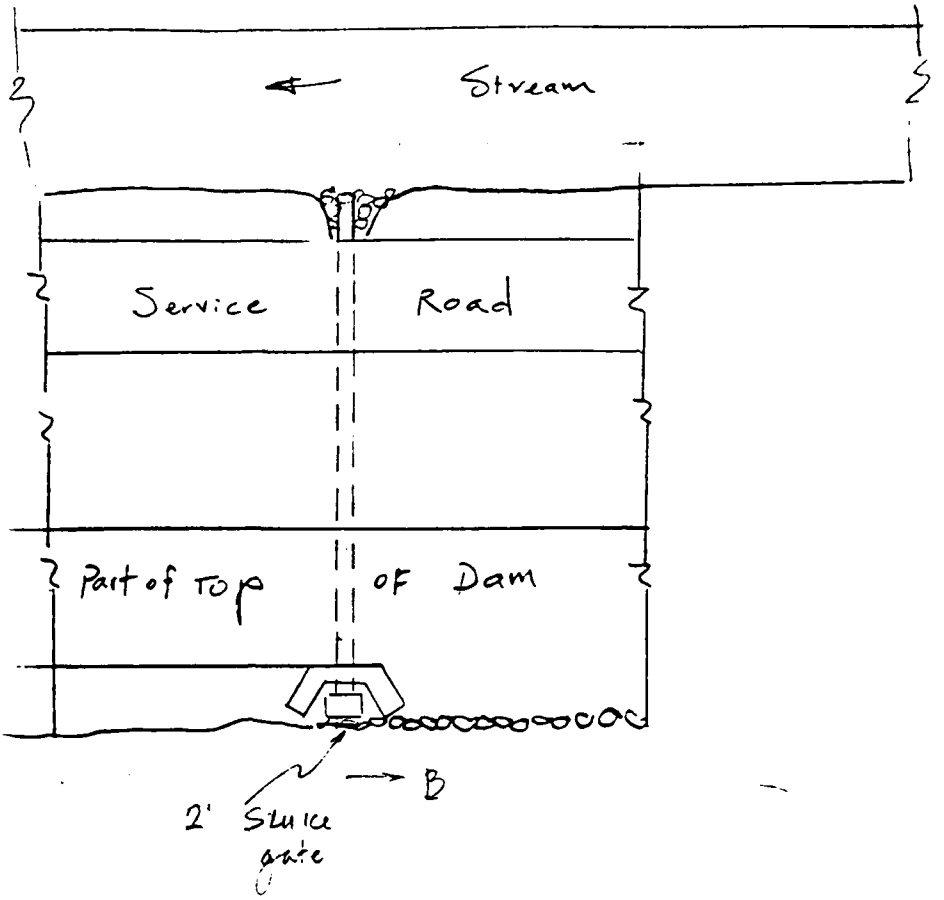
The values of total depth are obtained by Plotting

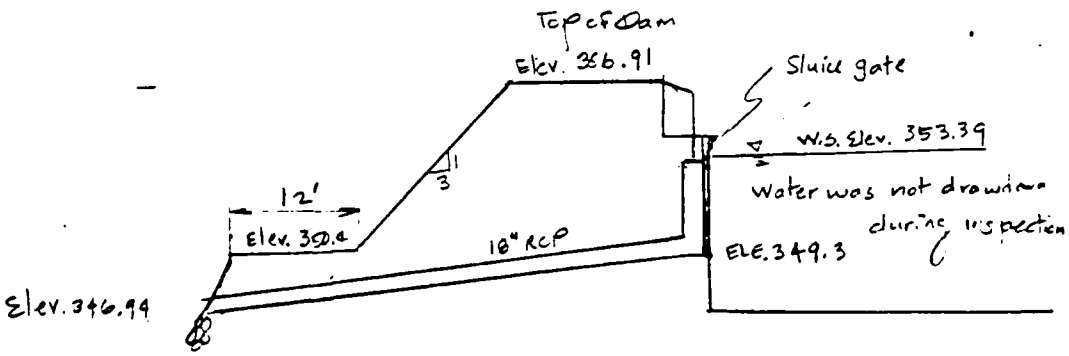
FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

SUBJECT N.J. DAM SAFETY INSPECTION SHEET NO. 9 OF 11
SHADOW LAKE DAM JOB NO. 10-83-01
COMPUTED BY C.L.C. CHECKED BY R.K. DATE 2/20/80

PRC Harris, Inc.
CONSULTING ENGINEERS

SUBJECT NJ Dam Insp Prog. Group XVII
Shadow Lake
COMPUTED BY E.K CHECKED BY C.C
SHEET NO. 10 OF 11
JOB NO. 10-AT3-1
DATE 4/1/80





SECTION B-B

X-Section of Outlet Work

FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

SUBJECT NJ Dam Insp. Prog. Group XVII
Shadow Lake
COMPUTED BY B.K. CHECKED BY C.C.
SHEET NO. 11 OF 11
JOB NO. 0-A83-01
DATE 2/20/80

Drawdown computation from Sharp crest weir to Broad Crest weir

1) Removal of Flashboard $Q = 2.7 \times 24.5 \times H^{1.5}$ From Elev. 356 to 355
(From Sharp crest weir to Broad crest weir)

2) Drain from the 18" RCP Fig B-8 Small Dam below Elev. 355

Res. Ele.	Area Ac	Ave Area	Vol. Ac-Ft	Av Ele	H/D	Q Ave Outlet Discharge	t_1 time to drawdown $\frac{Vol \times 2t}{1.98 \times Q}$	Cul time hr.
356	22.97							
		21.84	21.84	355.5		23.4	6.0	6.0
355	20.7							
		19.55	19.55	354.5	3+7	21	11.3	17.3
354	18.40							
		16.47	16.47	353.5	2.8	18	11.09	28.4
353	14.54							
		12.84	12.84	352.5	2.13	15	10.38	38.8
352	11.13							
		9.66	9.66	351.5	1.47	11	10.64	49.4
351	8.18							
		6.93	6.93	350.5	0.9	5	16.80	66.2
350	5.68							
		4.94	3.46	349.65	0.23	1.3	182.9	249.6
349.3	4.20							

Time of complete drawdown without in-flow = 249.6 hr ≅ 10 days

$A_1 = \frac{A_L}{(\frac{h}{H_T} + 1)^2}$ $h + H_T = 9'$ $A_2 = 18.9$ Ac (from 354 to 349.3)

```
A1                N J DAM SAFETY INSPECTION PROGRAM---GROUP XVII  10A8301
A2                N J 00232 SHADOW LAKE, BERGEN COUNTY, NJ
A3                MULT RATIO ROUTING.FRC-HARRIS INC., WOODBRIDGE, N J
B     144         0       5                                 0       0       4
B1      5
J       1         9       1
J1    1 0         8       .7      .6      .5      .4      .3      .2      .1
K       0     LAKE                      0       0       1
N1                  INFLOW HYDROGRAPH THROUHG SHADOW LAKE
M                 2     1.94            1.94
O      72
O1   0.01    0.01    0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.03
O1   0.03    0.03    0.03    0.03    0.03    0.03    0.03    0.04    0.04    0.04
O1   0 04    0.04    0.04    0.05    0.05    0.05    0.07    0.08    0.09    0.10
O1   0.11    0.13    0.19    0.29    0.51    0.77    0.36    0.23    0.15    0.12
O1   0.10    0 10    0.09    0.08    0.06    0.05    0.05    0.05    0.04    0.04
O1   0.04    0.04    0.04    0.03    0.03    0.03    0.03    0.03    0.03    0.03
O1   0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02    0.02
O1   0.01    0.01
T                                                     1.0     0.10
N2              0.90
X      -1     - .05       2
K       1      DAM                      0       0       1
K1                 ROUTING DISCHARGE THROUGH DAM
Y                                  1       1
Y1      1                                          -355.0       0
$A      0    18.4    34.0
$E    345     354     360
$$  355.0    24.5     3.3     1.5
$D356.91    2.70     1.5     537
K      99
A
A
A
A
A
```

N J DAM SAFETY INSPECTION PROGRAM --GROUP XVII 10A8301
N J 00232 SHADOW LAKE, BERGEN COUNTY, NJ
MULT RATIO ROUTING,PRC-HARRIS INC., WOODBRIDGE, N J

JOB SPECIFICATION

NQ	NDR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
144	0	5	0	0	0	0	0	3	0
			JOPER	NWT	LROPT	TRACE			
			3	0	0	0			

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH THROUHG SHADOW LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
LAKE	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	2	1.94	0.00	1.94	0.00	0.000	0	0	0

PRECIP DATA

NP	STORM	RAJ	RAK
72	0.00	0.00	0.00

PRECIP PATTERN

01	01	.02	.02	.02	02	.02	.02	.02	.03
03	03	.03	03	.03	.03	.03	04	04	04
04	04	.04	.05	.05	05	.07	08	.09	10
11	13	19	29	.51	77	.36	23	15	12
10	10	09	08	.06	05	05	05	04	04
04	04	04	03	.03	03	03	03	03	03
02	02	02	02	.02	.02	02	.02	02	02
01	01								

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.10	0.00	0.00

UNIT HYDROGRAPH DATA

TC= 0.00 LAG= .90

RECESSION DATA

STRTQ= -1.00 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 56 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .90 VOL= 1.00

26	83	158	253	376	526	687	824	921	975
992	988	954	898	833	760	671	565	476	409
353	305	266	233	202	176	149	131	113	98
85	73	63	54	47	41	36	31	27	23
20	17	15	13	11	10	9	8	7	6
5	4	3	2	1	0				

MO	DA	HR	MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO	DA	HR	MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1	01		05	1	01	0.00	01	2	1	01	6	05	73	0.00	0.00	0.00	369
1	01		10	2	01	0.00	01	2	1	01	6	10	74	0.00	0.00	0.00	341
1	01		15	3	02	0.00	02	2	1	01	6	15	75	0.00	0.00	0.00	314
1	01		20	4	02	0.00	02	1	1	01	6	20	76	0.00	0.00	0.00	288
1	01		25	5	02	0.00	02	1	1	01	6	25	77	0.00	0.00	0.00	263
1	01		30	6	02	0.00	02	1	1	01	6	30	78	0.00	0.00	0.00	239
1	01		35	7	02	0.00	02	1	1	01	6	35	79	0.00	0.00	0.00	216
1	01		40	8	02	0.00	02	1	1	01	6	40	80	0.00	0.00	0.00	194
1	01		45	9	02	0.00	02	1	1	01	6	45	81	0.00	0.00	0.00	174
1	01		50	10	03	0.00	03	1	1	01	6	50	82	0.00	0.00	0.00	154
1	01		55	11	03	0.00	03	1	1	01	6	55	83	0.00	0.00	0.00	138
1	01	1	00	12	03	0.00	03	1	1	01	7	00	84	0.00	0.00	0.00	129
1	01	1	05	13	03	0.00	03	1	1	01	7	05	85	0.00	0.00	0.00	120
1	01	1	10	14	03	0.00	03	1	1	01	7	10	86	0.00	0.00	0.00	112
1	01	1	15	15	03	0.00	03	1	1	01	7	15	87	0.00	0.00	0.00	105
1	01	1	20	16	03	0.00	03	1	1	01	7	20	88	0.00	0.00	0.00	98
1	01	1	25	17	03	0.00	03	1	1	01	7	25	89	0.00	0.00	0.00	91
1	01	1	30	18	04	0.00	04	1	1	01	7	30	90	0.00	0.00	0.00	85
1	01	1	35	19	04	0.00	04	1	1	01	7	35	91	0.00	0.00	0.00	79
1	01	1	40	20	04	0.00	04	0	1	01	7	40	92	0.00	0.00	0.00	74
1	01	1	45	21	04	0.00	04	0	1	01	7	45	93	0.00	0.00	0.00	69
1	01	1	50	22	04	0.00	04	0	1	01	7	50	94	0.00	0.00	0.00	65
1	01	1	55	23	04	0.00	04	0	1	01	7	55	95	0.00	0.00	0.00	60
1	01	2	00	24	05	0.00	05	0	1	01	8	00	96	0.00	0.00	0.00	56
1	01	2	05	25	05	0.00	05	0	1	01	8	05	97	0.00	0.00	0.00	52
1	01	2	10	26	05	0.00	05	0	1	01	8	10	98	0.00	0.00	0.00	49
1	01	2	15	27	07	0.00	07	0	1	01	8	15	99	0.00	0.00	0.00	46
1	01	2	20	28	08	0.00	08	0	1	01	8	20	100	0.00	0.00	0.00	43
1	01	2	25	29	09	03	06	1	1	01	8	25	101	0.00	0.00	0.00	40
1	01	2	30	30	10	09	01	5	1	01	8	30	102	0.00	0.00	0.00	37
1	01	2	35	31	11	10	01	15	1	01	8	35	103	0.00	0.00	0.00	35
1	01	2	40	32	13	12	01	33	1	01	8	40	104	0.00	0.00	0.00	32
1	01	2	45	33	19	18	01	65	1	01	8	45	105	0.00	0.00	0.00	30
1	01	2	50	34	29	28	01	117	1	01	8	50	106	0.00	0.00	0.00	28
1	01	2	55	35	51	50	01	202	1	01	8	55	107	0.00	0.00	0.00	26
1	01	3	00	36	77	76	01	337	1	01	9	00	108	0.00	0.00	0.00	24

	5 05	37	36	35	01	526	1 01	9 05	109	0 00	0 00	0 00	23
	5 10	38	23	22	01	763	1 01	9 10	110	0 00	0 00	0 00	21
	5 15	39	15	14	01	1043	1 01	9 15	111	0 00	0 00	0 00	20
1 01	5 20	40	12	11	01	1361	1 01	9 20	112	0 00	0 00	0 00	19
1 01	5 25	41	10	09	01	1703	1 01	9 25	113	0 00	0 00	0 00	17
1 01	5 30	42	10	09	01	2039	1 01	9 30	114	0 00	0 00	0 00	16
1 01	5 35	43	09	08	01	2331	1 01	9 35	115	0 00	0 00	0 00	15
1 01	5 40	44	08	07	01	2559	1 01	9 40	116	0 00	0 00	0 00	14
1 01	5 45	45	06	05	01	2715	1 01	9 45	117	0 00	0 00	0 00	13
1 01	5 50	46	05	04	01	2799	1 01	9 50	118	0 00	0 00	0 00	12
1 01	5 55	47	05	04	01	2821	1 01	9 55	119	0 00	0 00	0 00	11
1 01	6 00	48	05	04	01	2785	1 01	10 00	120	0 00	0 00	0 00	11
1 01	6 05	49	04	03	01	2701	1 01	10 05	121	0 00	0 00	0 00	10
1 01	6 10	50	04	03	01	2580	1 01	10 10	122	0 00	0 00	0 00	9
1 01	6 15	51	04	03	01	2426	1 01	10 15	123	0 00	0 00	0 00	9
1 01	6 20	52	04	03	01	2246	1 01	10 20	124	0 00	0 00	0 00	8
1 01	6 25	53	04	03	01	2052	1 01	10 25	125	0 00	0 00	0 00	8
1 01	6 30	54	03	02	01	1868	1 01	10 30	126	0 00	0 00	0 00	7
1 01	6 35	55	03	02	01	1702	1 01	10 35	127	0 00	0 00	0 00	7
1 01	6 40	56	03	02	01	1552	1 01	10 40	128	0 00	0 00	0 00	6
1 01	6 45	57	03	02	01	1418	1 01	10 45	129	0 00	0 00	0 00	6
1 01	6 50	58	03	02	01	1297	1 01	10 50	130	0 00	0 00	0 00	5
1 01	6 55	59	03	02	01	1187	1 01	10 55	131	0 00	0 00	0 00	5
1 01	7 00	60	03	02	01	1086	1 01	11 00	132	0 00	0 00	0 00	5
1 01	7 05	61	02	01	01	994	1 01	11 05	133	0 00	0 00	0 00	4
1 01	7 10	62	02	01	01	909	1 01	11 10	134	0 00	0 00	0 00	4
1 01	7 15	63	02	01	01	835	1 01	11 15	135	0 00	0 00	0 00	4
1 01	7 20	64	02	01	01	768	1 01	11 20	136	0 00	0 00	0 00	4
1 01	7 25	65	02	01	01	706	1 01	11 25	137	0 00	0 00	0 00	3
1 01	7 30	66	02	01	01	650	1 01	11 30	138	0 00	0 00	0 00	3
1 01	7 35	67	02	01	01	598	1 01	11 35	139	0 00	0 00	0 00	3
1 01	7 40	68	02	01	01	551	1 01	11 40	140	0 00	0 00	0 00	3
1 01	7 45	69	02	01	01	507	1 01	11 45	141	0 00	0 00	0 00	2
1 01	7 50	70	02	01	01	467	1 01	11 50	142	0 00	0 00	0 00	2
1 01	7 55	71	01	00	01	432	1 01	11 55	143	0 00	0 00	0 00	2
1 01	8 00	72	01	00	01	399	1 01	12 00	144	0 00	0 00	0 00	2
									SUM	5 20	3 84	1 36	58761
										(132)	(98)	(35)	(1663 93)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2821	809	408	408	58762
CMS	80	23	12	12	1664
INCHES		3 80	3 91	3 91	3 91
MM		98 56	99 40	99 40	99 40
AC-FT		401	405	405	405
HOURS CU M		475	499	499	499

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HYDROGRAPH ROUTING

ROUTING DISCHARGE THROUGH DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DAM	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
0.0	0.000	0.00	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-355.	0

SURFACE AREA=	0.	18.	34.
CAPACITY=	0	55.	210.
ELEVATION=	345.	354.	360.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
355.0	24.5	3.3	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
356.9	2.7	1.5	537.

PEAK OUTFLOW IS 2714. AT TIME 4.08 HOURS

PEAK OUTFLOW IS 2136. AT TIME 4.08 HOURS

PEAK OUTFLOW IS 1842. AT TIME 4.17 HOURS

PEAK OUTFLOW IS 1549. AT TIME 4.17 HOURS

PEAK OUTFLOW IS 1242 AT TIME 4.25 HOURS

PEAK OUTFLOW IS 924. AT TIME 4.33 HOURS

PEAK OUTFLOW IS 584. AT TIME 4.50 HOURS

PEAK OUTFLOW IS 222. AT TIME 5.00 HOURS

PEAK OUTFLOW IS 93. AT TIME 5.17 HOURS

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00	RATIO 2 .80	RATIO 3 .70	RATIO 4 .60	RATIO 5 .50	RATIO 6 .40	RATIO 7 .30	RATIO 8 .20	RATIO 9 .10
HYDROGRAPH AT	LAKE	1.94	1	2821.	2257.	1975.	1693.	1411.	1129.	846.	564.	282.
		(5.02)	(	79.90)(	63.92)(	55.93)(	47.94)(	39.95)(	31.96)(	23.97)(	15.98)(	7.99)
ROUTED TO	DAM	1.94	1	2714.	2136.	1842.	1549.	1242.	924.	584.	222	93.
		(5.02)	(	76.84)(	60.50)(	52.16)(	43.87)(	35.16)(	26.17)(	16.53)(	6.28)(	2.63)

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	355.00	355.00	356.91
STORAGE	75.	75.	119.
OUTFLOW	0.	0.	213.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	358.25	1.34	155.	2714.	3.58	4.08	0.00
.80	358.03	1.12	149.	2136.	3.33	4.08	0.00
.70	357.91	1.00	145.	1842.	3.08	4.17	0.00
.60	357.78	.87	142.	1549.	3.00	4.17	0.00
.50	357.64	.73	138.	1242.	2.75	4.25	0.00
.40	357.47	.56	133.	924.	2.33	4.33	0.00
.30	357.27	.36	128.	584.	1.83	4.50	0.00
.20	356.93	.02	119.	222.	.50	5.00	0.00
.10	356.10	0.00	99.	93.	0.00	5.17	0.00

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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
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